Concrete

Vol. 37 Chicago, September, 1930 No. 3

Modern Methods and Equipment Used on American Can Building

Concrete Mixing Plant, Belt Conveyor Distribution of Concrete and Extensive Use of Metal Forms Are Features in Construction of Chicago Building—Strength of Concrete Far Above Requirements—Building Designed for 250-lb. Live Load

By M. THOMPSON
Superintendent of Construction, American Can Co., Englewood Plant, Chicago, Illinois

MODERN construction equipment and methods are being employed in the new addition to the Englewood factory of the American Can Company in Chicago, located at Western Ave. and Sixtieth St. Among the features of interest to contractors and construction superintendents are the concrete mixing plant, the control of the strength of concrete and the strengths attained, the distribution of concrete by a series of belt conveyors, and the use of metal forms in floors as well as columns.

Million Square Feet of Floor Area

This new structure now being added to the north of the present building will have nearly a million square feet of floor area. The new building is 610 ft. long from east to west, 258 ft. wide, and will have five stories above grade, and a deep basement.

The story heights, beginning with the first, are 17½, 15, 15, 15, and 17½ ft., respectively, above which there is an additional height of about 12 ft. in the saw-tooth roof construction.

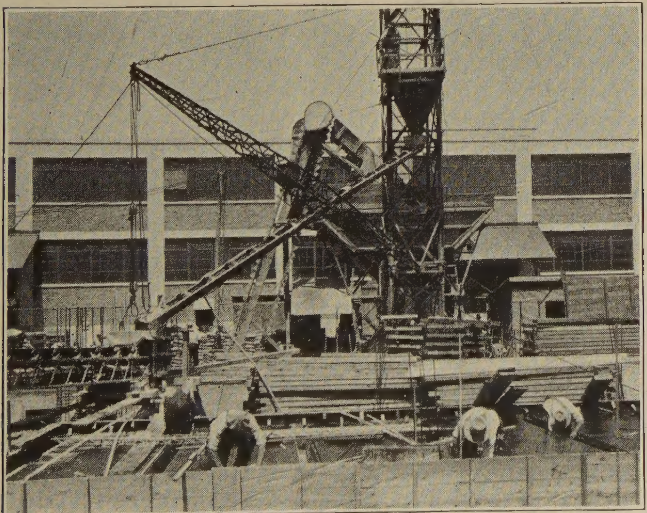

Figure 1. Concrete mixing plant at American Can Company's new building

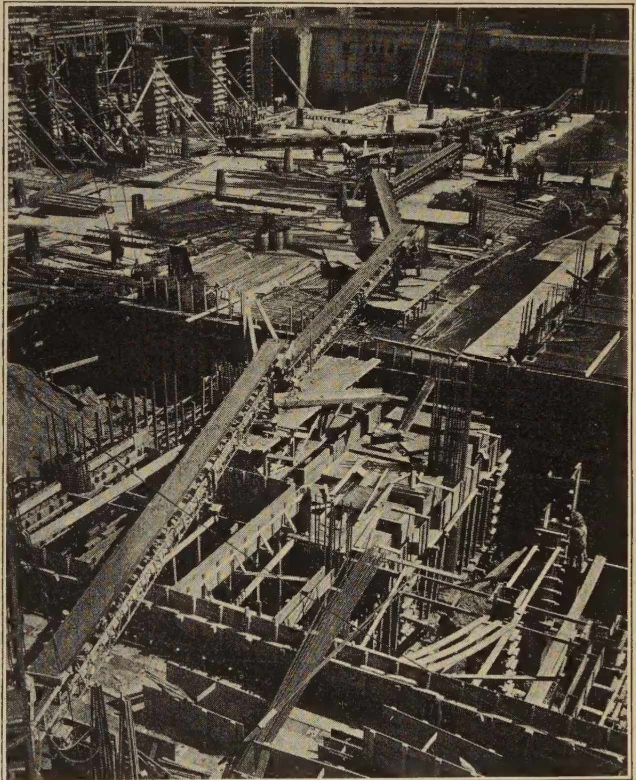

Figure 2. View from point near concrete mixing plant, showing distribution of concrete by a series of belt conveyors

In addition to the main structure just described, a new boiler house is being built at the east end, 60 by 94 ft. in plan, and two stories high, plus a basement.

The General Layout and Design

The layout of the building makes provision for four railway tracks from the B. & O. Chicago Terminal Railway, which enter the building at a level 42 in. below the first floor, this being the proper height for loading and unloading from freight cars. These tracks extend practically the full length of the building, in two pairs, but occupying four bays. Through this arrangement each track is served by a loading platform.

While the dimensions of the floor bays vary, the average dimension is not far from 22 by 23 ft. The design is the conventional flat-slab type, with drop panels, all floors except the fifth being designed for a live load of 250 lb. per sq. ft. The fifth floor is designed to support a live load of 400 lb. per sq. ft. To support this heavy design load the spirally reinforced concrete circular columns are made of stronger concrete than that in the floors, and the amount of vertical steel is at or near the full limit of 8 per cent permitted by the Chicago building code. The diameter of the basement columns ranges from 24 to 34 in.

Column Footings of Unusual Size

The column footings are the spread reinforced concrete type, with sloping sides, the bottom 6 in. having vertical sides. Because of the heavy loading and the necessity of maintaining a moderate unit soil pressure, the footings are quite large in area, many of them being about 20 ft. square. The total footing area is about 75 per cent of the ground area. At several points the column loads are so heavy that it was found necessary to support a number of columns on one spread footing. One such footing supports 10 columns and contains 300 cu. yd. of concrete. Several others support six columns each.

The Concrete Mixing Plant

Since the quantity of concrete to be placed amounts to about 75,000 cu. yds., the mixing plant was designed to speed up the handling of both the raw materials and the mixed concrete so that about 700 cu. yds. might be placed daily.

A good view of the mixing plant, located at about the middle of the north side of the project, is shown in Figure 1. At the left of the hoisting tower, and a little beyond it, may be seen the Weller bucket conveyor that in an hour's time fills the 75-yd. Johnson sand or gravel bins above the mixers.

From the aggregate bins the sand and gravel are delivered to the mixers by gravity, through weighing and measuring devices. Three mixers are used in the main concrete mixing plant. One is a 1-yd. Jaeger mixer, one a ½-yd. Koehring, and another a ½-yd. Oshkosh mixer. A second 1-yd. mixer would have been preferable in place of the two ½-yd. machines, but the latter were on hand and were put to use. A fourth mixer, also of ½-yd. capacity, is employed wherever needed, on miscellaneous concrete work.

A Johnson hydrographic batcher controls the quantity of mixing water and also weighs the sand batches.

The quantity of water, including any water in the aggregate, is about 7 gallons to the sack of cement in concrete for the columns, and about 7½ gallons in concrete for floors. The mixing proportions are quite close to 1:2:4 for the floor concrete, and from 1:1½:3 to 1:1:2 for column concrete.

High-Strength Concrete

With the water-cement ratios employed the actual 28-day strengths of the concrete are far above the strengths required by the specifications. One set of specimens of concrete that was supposed to have a strength of not less than 2,000 lb. per sq. in. at 28 days actually had strengths ranging from 4,284 to 4,810 lb. per sq. in. at that age. This particular concrete contained about 5 sacks to the cubic yard of concrete in place.

The mixing, proportioning, testing and inspection of the concrete work is under the supervision of the Robert W. Hunt Company, of Chicago.

Distributing Concrete with Belt Conveyors

The distribution of the concrete is accomplished by means of belt conveyors of the type first employed on the construction of the Merchandise Mart, in Chicago, in 1929.* The batches of concrete are delivered, as usual, to a skip at the base of the hoisting tower, elevated to the hopper at the head of the chute shown in Figure 1, then delivered to the first of a series of portable belt conveyors. Six of these conveyors, which are of Barber-Greene manufacture, are shown in operation in Figure 2, a view taken from a point near the concrete mixing plant. A seventh conveyor, not in use at the moment, may be seen in the distance.

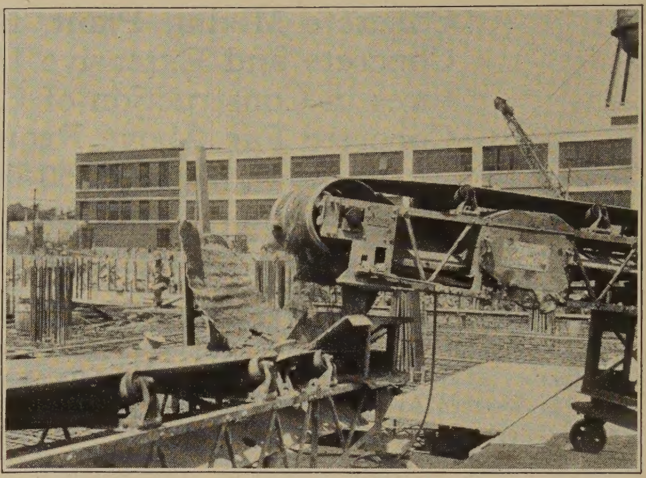

Figure 3. Concrete being delivered from one conveyor to another

One of the conveyors (the one nearest the mixing plant) is 52 ft. long, three are each 40 ft. long, two are 37 ft. each, and one is 34 ft.

Six men of the regular concrete placing crew are ordinarily required to shift the conveyors. The conveyors are supported on runways of the same strength and character of construction that would be built for the distribution of concrete by buggies. A close-up view showing concrete being delivered from one conveyor to the next may be seen in Figure 3. The view in Figure 4 shows the placing crew at work at the final point of delivery, where two short chutes which are easily shifted are used to bring the fresh concrete to the exact point desired.

The concrete work shown in the pictures just mentioned (Figures 2 to 4) is on the first floor of the structure. As the concreting progresses, story by story, the belt conveyors are hoisted to the next story, always operating on the floor being concreted.

The use of these belt conveyors permits great flexibility in the placing of concrete. In one instance, when some construction operation was under way directly between the mixing plant and the place where concrete was to be deposited, the conveyors were detoured around the obstruction in a U-shaped route, so that neither operation interfered with the other. Furthermore, the use of the conveyors is resulting in direct economy, for they take the place of some 14 or 15 men who otherwise would be required to wheel distributing buggies.

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*See October, 1929, issue of Concrete, pages 13 to 16.

Metal Form Work

The metal form work on this project is of interest because of its use not only for the columns and the column heads, but also for the drop panels and the floor panels, where wooden form panels are ordinarily employed.

So far as the metal forms for the columns and column heads are concerned, there is little that is new about them. One of the forms for a column head can be seen in the middle distance in Figure 5.

These metal forms, which are supplied by the Deslauriers Column Mould Company and are rented from that organization and erected and taken down by their own crews, are made up in units of sheet metal, strengthened with small angles riveted around the edges and small channels similarly riveted at intermediate points.

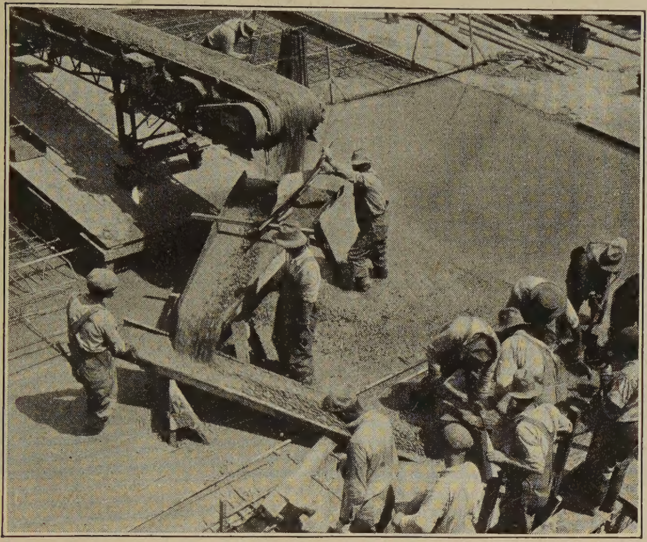


Figure 4. Two short chutes, easily shifted, finally deliver the concrete to the exact point required

The forms for the drop panels in this flat-slab construction are made up in two parts, each part containing half the semi-circular opening made by the column head. These drop panel forms are supported from the story below by jack frames made of 4-by-4 wooden posts and 4-by-6 jackheads, spaced approximately 4 ft. apart. The supports for the drop panel form work are kept independent of the supports for the remainder of the floor panel.

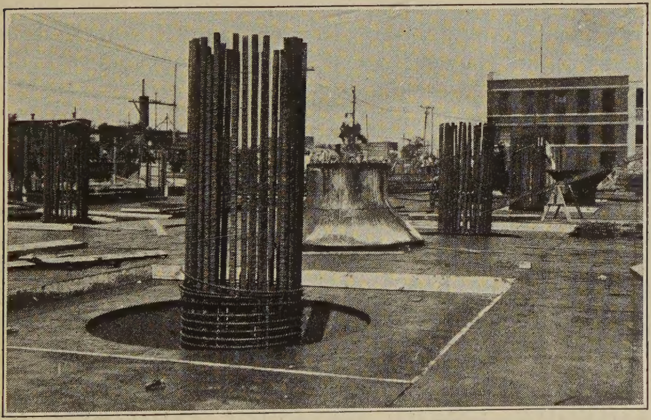


Figure 5. Metal form work in place, before steel reinforcement is set

The floor panel forms consist of rectangular panels of sheet metal, also strengthened around the four sides by small angles (1⅜ by 1⅜ in. in size), and by two intermediate channels of similar depth, all riveted to the sheet metal.

Panel Sizes

The dimensions of the floor form panels vary with the dimensions of the floor bays themselves, special sizes being used to fill out odd dimensions. A panel size that is used to a considerable extent on this work is 8 ft. long and 30 in. wide, strengthened, as usual, with small angles around the four sides and two intermediate channels running lengthwise. Other sizes are used, of course, but these dimensions will give the reader an idea of the size of the panels. The supports below are similar to those provided for the drop panel forms, namely, lines of 4-by-4 posts and 4-by-6 girts spaced two to the panel, or about 4 ft. apart. This provides supports for the metal panels at the ends and at mid-span, and with the panels thus supported they are strong enough to carry the construction loads and the fresh concrete. The panels form tight butt joints with adjoining panels, and when the forms are stripped the surface is smooth and true.

Figure 5 shows these metal forms in place, including a view into the top of the form for the column head, the drop panel forms and the floor panel forms. In this view the floor reinforcement had not been placed. Such reinforcement can be seen in parts of Figures 2, 3, and 4.

Material Requirements

This project, as stated, will require about 75,000 cu. yd. of concrete. Excavation work amounted to about 150,000 cu. yd. Reinforcing steel requirements will be 5,000 tons. The cost of the main addition will be around $3,000,000 and the boiler house and its equipment will add a quarter million more.

The building was designed by the American Can Company's own architectural and engineering department, and is being built by the company's construction organization. C. C. Preis is the architect and chief engineer in charge of designing work, and J. F. Abbey is general construction superintendent of the American Can Company. The writer is in immediate charge as construction superintendent on this project.

Pacific Coast Building Officials in Annual Conference

The ninth annual meeting of the Pacific Coast Building Officials' Conference is to be held at Long Beach, Calif., in the Virginia Hotel, from September 29th to October 4th, inclusive.

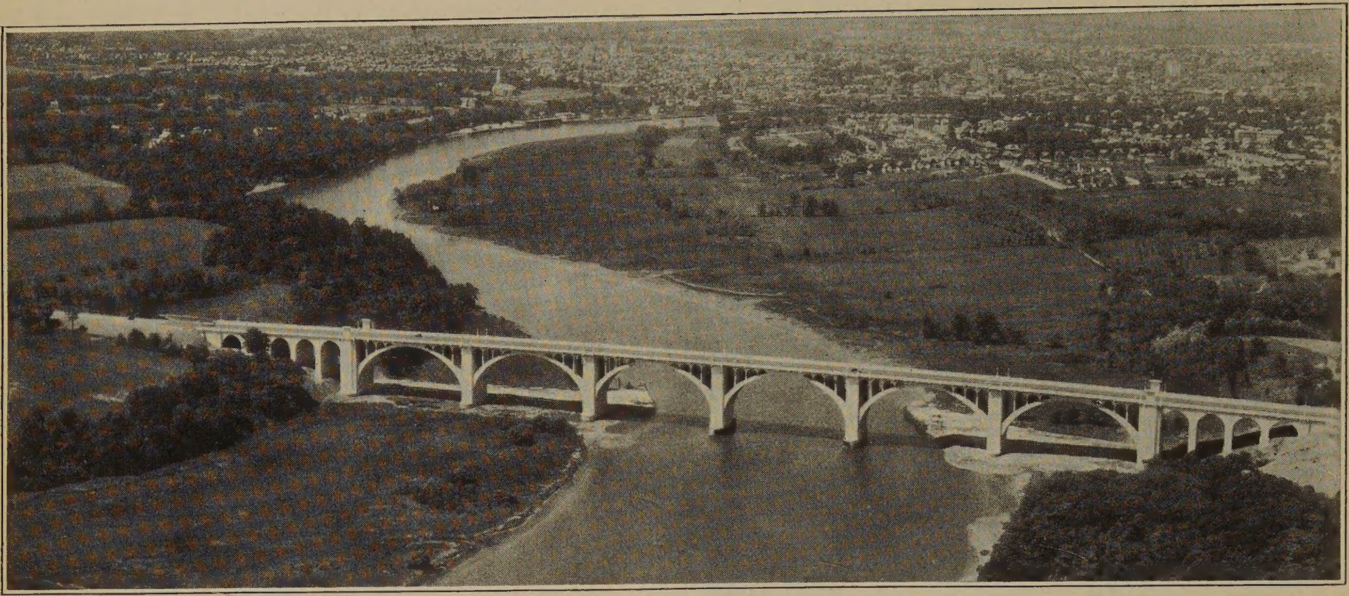
Among the subjects scheduled for papers and discussions is one on "Licensing of Contractors," by James F. Collins, director of the State Department of Professional and Vocational Standards; a symposium on methods for enforcing city building regulations; a paper entitled "Methods Used by Underwriters' Laboratories in Making Standard Fire Tests," by H. G. Ufer, western superintendent of the Underwriters' Laboratories; and a paper on "Fire Districts in Western Cities," by A. C. Horner, of the National Lumber Manufacturers' Association.

A new feature of this meeting is the "code discussion breakfast," scheduled for three days at 7:30 in the morning, during which the uniform building code prepared by this organization will be under discussion. Several inspection tours and an ocean trip will be other attractions on the program.

David H. Merrill, 19 Pine Ave., Long Beach, Calif., is managing secretary of the Pacific Coast Building Officials' Conference. Paul C. Graham, Long Beach, is general chairman of the seven committees on local arrangements.

Two Concrete Bridges Win Fowler Awards

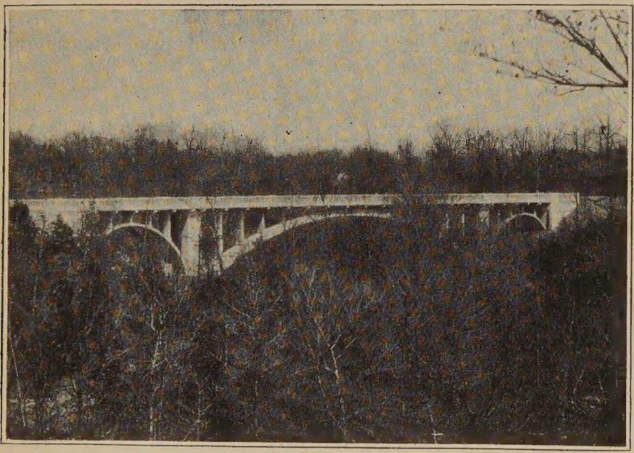
Designers of reinforced concrete bridges of outstanding architectural merit have won two of the three prizes in the Phebe Hobson Fowler Architectural Award of the American Society of Civil Engineers for the year 1930.



Raritan River bridge, in New Jersey, shown above, was awarded first prize by the Phebe Hobson Fowler Architectural Award Committee

The first prize, a gold bronze medallion, was awarded to Morris Goodkind, bridge engineer of the New Jersey State Highway Commission, for the design of the Raritan River bridge near New Brunswick, N. J. The general contractors were Parker & Graham, Inc., of Paterson, N. J.

The third prize, an honorable mention and certificate, was awarded to G. F. Burch, bridge engineer, Illinois Division of Highways, for the design of the Dixon Springs bridge in Pope County, Illinois. The general contractor was the Ferguson Construction Co., of Rockford, Ill.



Dixon Springs bridge, in Illinois, another concrete structure, was awarded third prize for its architectural merit

Both of the concrete prize-winning bridges are of the multiple-arch, open spandrel type of design. Concrete is a material which is exceptionally well suited to architectural treatment in the open spandrel arch type.

The Phebe Hobson Fowler Architectural Award was established in 1928 by Charles Evan Fowler, a consulting engineer of New York, for the purpose of giving recognition to designers of bridges or other engineering structures of outstanding architectural appearance. Bridges are designated as the subjects preferred for awards; but in the absence of a meritorious bridge design awards may be made to other kinds of engineering structures, such as dams, water towers, tunnel portals, power houses or lighthouses.

Instructions on the manner of submitting the necessary photographs and other data for the consideration of the award committee were published on page 24 of the January (1930) issue of CONCRETE. It is considered proper for a designer who has a meritorious structure to his credit to initiate the submission of the data required.

St. Louis Is Choice of Road Builders for 1931 Convention

St. Louis has been selected as the place for holding the 1931 meeting and road show of the American Road Builders Association. The date is from January 10th to 16th, inclusive, the convention and road show opening officially January 12th.

Hotel headquarters will be at the Statler and the Jefferson, and equipment will be exhibited at the Highlands Arena and Exhibition buildings.

Some of the subjects under consideration for the program are the construction of roads and road surfaces, and subgrade and pavement bases. In a report on central and transit mixed concrete, particular attention will be paid to the methods and equipment used in the transportation and delivery of the concrete to the subgrade.

Haydite Legal Decision Affirmed by Court of Appeals

The Seventh Circuit Court of Appeals, sitting in Chicago, has affirmed the decision of the District Court for the Eastern District of Illinois, which ruled in favor of the Haydite Company and the Western Brick Company in a suit for infringement brought by the Silica Products Company in behalf of the Olsen patents. The district court had ruled that the Hayde and Olsen patents covering the manufacture of light-weight concrete aggregates do not apply to the same process.

Old Pavements Embedded in Widened Highways

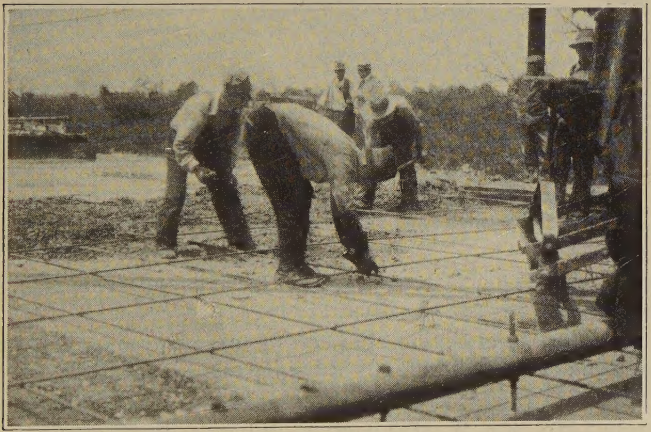
Two Widening Projects on Indiana Highways Described—New Side Strips Are 9-7-9 Sections—Old Pavement Covered with 5-Inch Reinforced Concrete Slab—Roads Kept Open to Traffic—Some Construction Kinks

THE National Old Trails Road out of Indianapolis is now a smooth concrete road 40 ft. wide. The 40-ft. width extends for almost four miles to the Pennsylvania Railroad grade separation. As this structure is not wide enough to permit a 40-ft. roadway, from there into Bridgeport, nearly two miles, the road is 30 ft. wide.

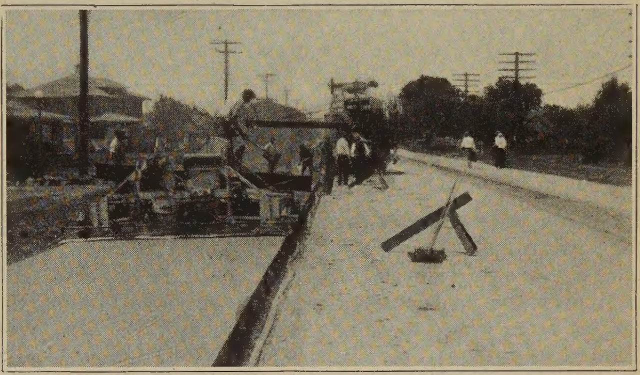
The old pavement, built eight years ago, was only 18 ft. wide all the way from Bridgeport to Indianapolis. Such a width was wholly inadequate for the tremendous volume of traffic over this popular route. The old concrete pavement, a 6-8-6 cross-section, was in good condition but the design required modernization, and this meant increased width. The Indiana Highway Department has worked out a design to meet such a condition and economize by salvaging the old road. The National Old Trails section was the first to be built from this design, and this was followed by another project north of South Bend. Other widening and resurfacing projects are proposed or under construction.

Design of Widened Section Utilizes Old Pavement

The design, as shown by the sketch, consists of two thickened edge slabs 10 ft. wide and the resurfaced center portion. The resurface is a minimum thickness of 5 in. over the old pavement and 9 in. thick for the additional foot on each side. Reinforcement is placed over the center portion only and consists of an assembled bar-mat, the members of which are ½-in. square deformed bars.



Bar-mat reinforcement over old pavement was held in correct position with metal supports



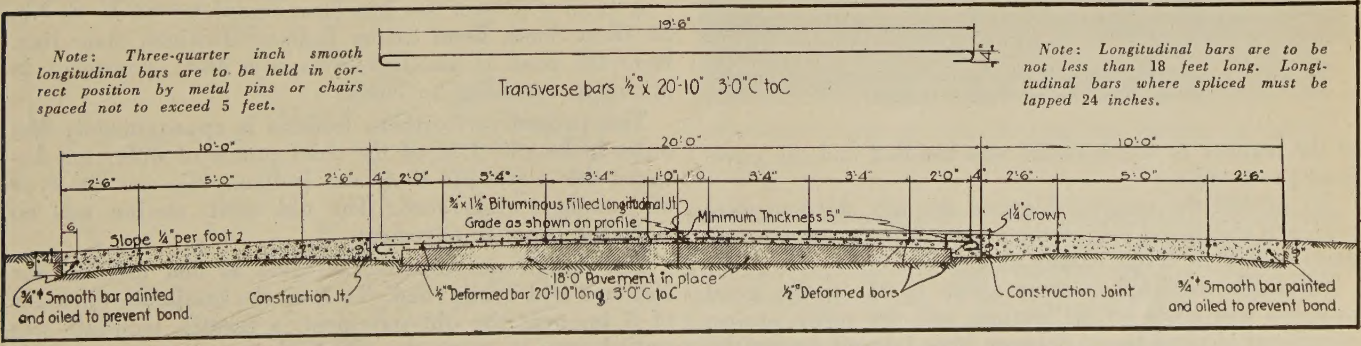
Placing the second 10 ft. side strip on the 40 ft. section of the National Old Trails road out of Indianapolis

The transverse bars are 20 ft. 10 in. long and bent around 180 deg. for anchorage. There are two construction joints where the side slabs join the center portion and a longitudinal dummy joint 1½ in. deep and ¾ in. wide is cut down the center of the middle section.

Maintaining Traffic During Construction

On this type of construction the contractor is required to maintain traffic during construction. The 30-ft. section of the National Road was built first. A short detour was necessary for this part of the work, as the full width was placed at one time.

After the completion of the 30-ft. section from the Pennsylvania Railroad overhead crossing to Bridgeport, work was commenced on the north 10-ft. strip of the 40-ft. pavement into Indianapolis. The south 10-ft. strip was con-

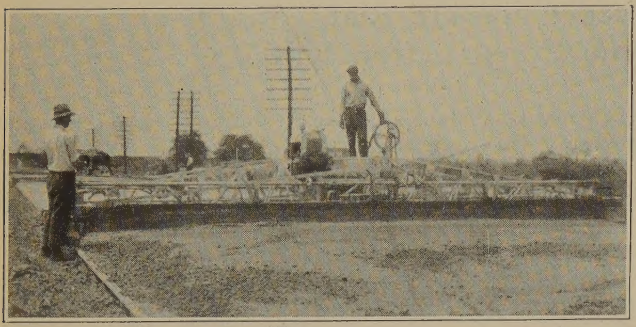


Note: Three-quarter inch smooth longitudinal bars are to be held in correct position by metal pins or chairs spaced not to exceed 5 feet.
19'6"
Transverse bars ½" x 20'10" 3'0" C to C
Note: Longitudinal bars are to be not less than 18 feet long. Longitudinal bars where spliced must be lapped 24 inches.
10'0"
20'0"
10'0"
2'6"
5'0"
2'6"
4"
2'0"
3'4"
3'4"
1'0"
1'0
3'4"
3'4"
2'0"
4"
2'6"
5'0"
2'6"
¾"x 1½" Bituminous Filled Longitudinal Jt.
Grade as shown on profile
Minimum Thickness 5"
1¼" Crown
6
Slope ¼" per foot
¾" Smooth bar painted and oiled to prevent bond.
Construction Jt.
18'0" Pavement in place
½" Deformed bar 20'10" long 3'0" C to C
½" Deformed bars
Construction Joint
¾" Smooth bar painted and oiled to prevent bond.

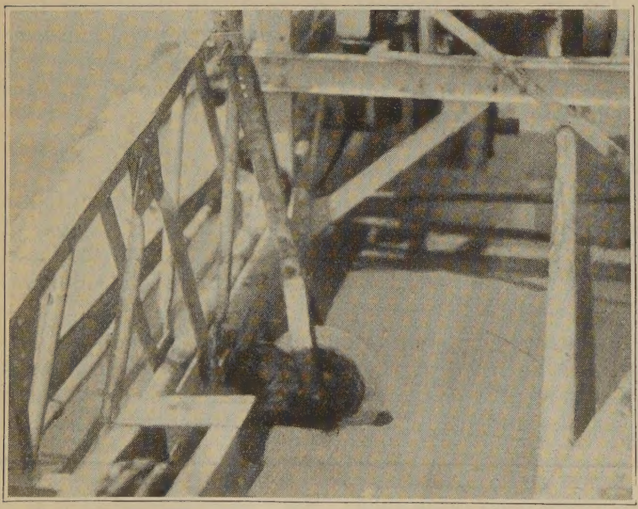
Cross-section of 40-ft. pavement with old 18-ft. pavement embedded structed next, while traffic was maintained over the old pavement in the center.

At all intersections gaps were left in the 10-ft. side sections so that cross-traffic could pass through or get on to the center part of the road. These gaps were paved later with high-early-strength concrete. At the time these gaps were paved the slab on either side was strong enough to carry traffic. In this way traffic on the cross roads was never inconvenienced.

In placing concrete for both the center and side sections the mixer was operated over the old pavement. During the paving of the center resurface section, traffic was maintained over the side sections that could be opened, and then over the center portion at the opposite end of the project from where the mixer was working.


A 30-ft. finishing machine was used on the section near Bridgeport, which is 30 ft. wide to the Pennsylvania R. R. viaduct overhead

Barricades constructed in the form of half horses were used to keep traffic off newly completed sections. The barricades were painted red with yellow letters. A test made at night showed that these colors made the barricades easily discernible. The fact that there is not a suggestion of a wheel mark on the new pavement is a tribute to the manner in which traffic was handled and the pavement protected.


The dummy center joint was neatly made with a cutting wheel attached to the mechanical finisher

To protect the men working on the job, flagmen were stationed ahead and behind the mixer. There were no accidents caused by traffic to any of the men.

Although restricted to some extent by the traffic, good progress was made on all sections and the entire project completed in good time. Between May 1st and August 1st more than 126,000 sq. yd. of concrete was laid.

Aggregates from Central Proportioning Plant

The aggregates, with the exception of the cement, were measured by weight at a central proportioning plant and hauled to the mixer by truck. The average haul for the job was 3¼ miles.

A mechanical finisher followed close behind the mixer. The pavement was then floated with long-handled floats and the final belting was done with a hand-operated mechanical belter.

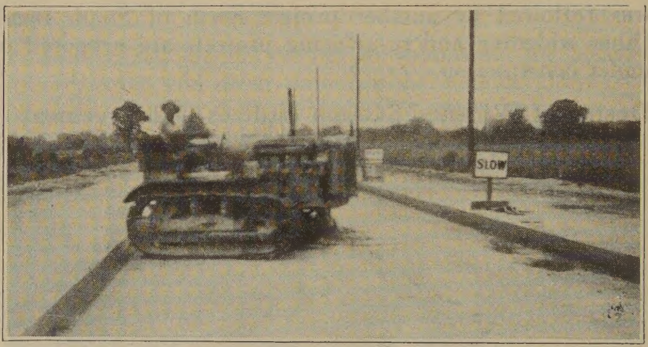
Two extra finishers were required on the center section in order to get a smooth riding surface and a good joint with the side sections. Extra floating was necessary because of the difference in the crown of the center and side sections. The 10-ft. side strips have a straight-line crown of two-tenths of an inch per foot, while the center section has a crown of one-tenth of an inch per foot.

Construction Kinks

To protect the hose supplying the mixer, the contractor hinged heavy planks together with old pieces of hose line. This device was then placed over the hose to the mixer, permitting traffic to pass over without damaging it.

It was necessary to keep the old pavement as clean as possible. In order to catch any mortar dripping from the mixer drum to the pavement, a large pan was kept under the mixer. Care also had to be exercised to keep mortar off the side sections when placing the center portion.

For making the dummy joint down the center a cutting wheel was attached to the mechanical strike-off. This wheel is shown in one of the illustrations.



The tread of a small tractor, skillfully revolved on the old asphalt pavement, scraped down the high spots

For the 10-ft. sections the contractor made an excellent subgrade template from an old subgrade planer.

The contractor for this work, which is listed as state project 201, was W. D. Vogel, of Indianapolis.

Another Important Road Widened

A similar project has just been completed on U. S. No. 31 from South Bend to the Indiana-Michigan state line. Here the road is matched by a new 40-ft. pavement in Michigan extending to Niles.

This project in Northern Indiana is approximately 4½ miles in length. One of the chief points of difference between this work and that near Indianapolis was the type of pavement resurfaced. The old 18-ft. section was an asphaltic concrete pavement.

The design was exactly the same as that used on the National Old Trails road. To keep the minimum thickness of 5 in. over the old pavement, a scratch template was pulled over it, using the edges of the new concrete side strips as rails. The high spots so marked were scraped

Placing bar-mat reinforcement over the center "re-tread" section of asphalt pavement

down by revolving the caterpillar tractor over the spot and then cleaning off the old pavement.

Ready-Mixed Concrete from Commercial Plant

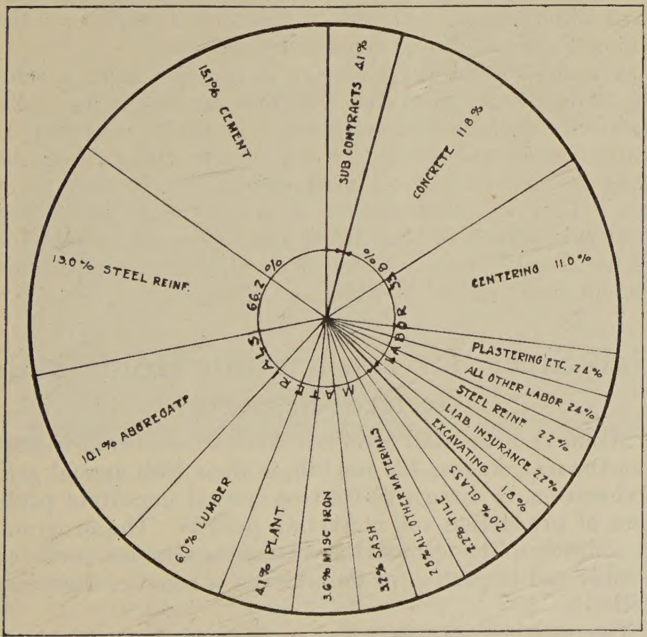
Concrete for this work was mixed at a commercial central mixing plant in South Bend. Tests made by the testing laboratory of Purdue University showed the average strength of this concrete to be 5140 lb. per sq. in. at 28 days. The actual weighed proportions of each batch were as follows: Cement, 1316 lb.; sand, 2397 lb.; pea gravel, 2150 lb.; gravel (¾ to 2 in.), 2150 lb. The water used was in the proportion of 5½ gallons per sack of cement. The Tri-Lake Construction Company of Columbia City, Ind., were the general contractors on this project.

These two modernizing projects are only the forerunners of other widening and resurfacing work on important traveled routes of the Indiana highway system.

An Index of Building Costs

Seven-Story Reinforced Concrete Industrial Building Is Basis of Estimates—Present Costs at Lowest Level Since 1922—Chart to Appear Every Three Months

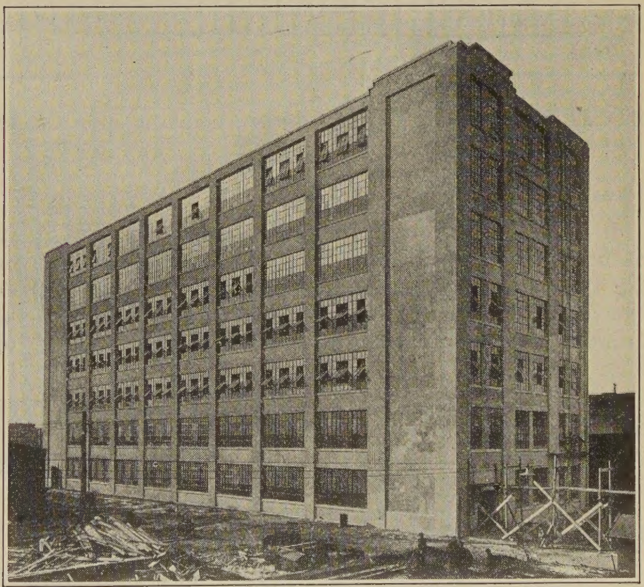
A 7-story reinforced concrete industrial building, forming a part of the Stanley Works at New Britain, Conn., and built in 1914 by the Aberthaw Company, of Boston, has served since that time as the basis for the Aberthaw Index of Cost of Building. The structure is a typical all-concrete building, 200 by 62 ft. in plan and 7 stories high, with average story heights, granolithic floors, and with two stair and elevator wells, in opposite corners. The building has no basement. The only feature that is out of the ordinary is that the building was designed for the unusually heavy live load of 500 lb. per sq. ft. This fact keeps the cost index somewhat higher than it would be for a building supporting ordinary manufacturing loads.



Proportions of labor and material in reinforced concrete building

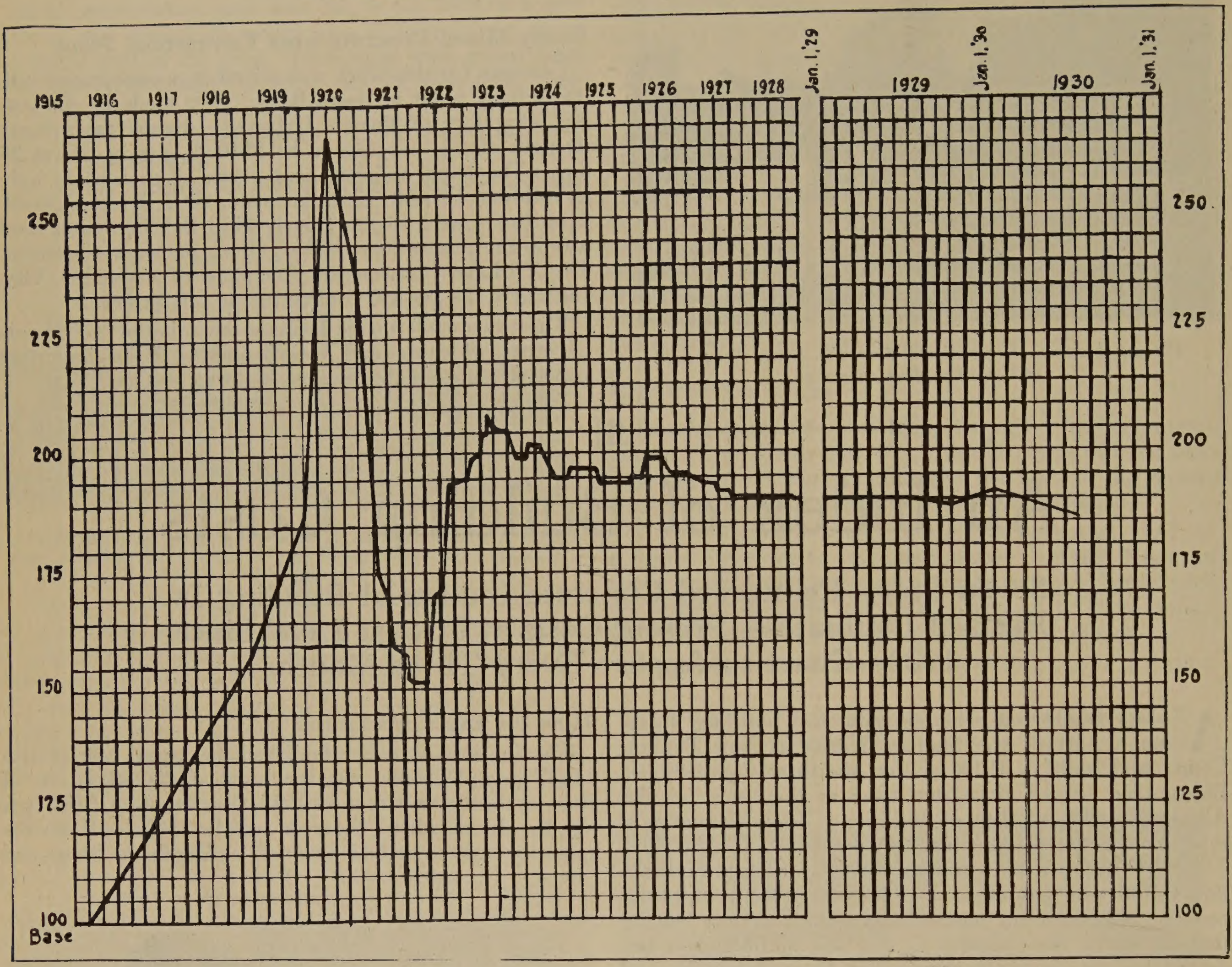
How the Index is Figured

Careful cost records established the actual cost of this building at $92,668. On the basis of 88,250 sq. ft. of floor area, the unit cost in 1914 was therefore $1.05 per sq. ft. Inasmuch as the cost records included both the quantity and the cost of material, and both the hours and pay-rate of labor, it is possible to make a reliable estimate of what the same building would cost at any given time. This can be done by applying the material prices and labor rates prevailing at the time for which the index is being figured. Thus the most recent index figure of 186 for July 1st, 1930, was obtained by computing the estimated cost as of July 1st, dividing that estimated cost by



Seven-story reinforced concrete industrial building on which cost index is based

Aberthaw Index of Cost of Building



the actual cost in 1914, and multiplying the quotient by 100.

Present Cost Per Sq. Ft.

It is possible also to obtain the present cost per sq. ft. of floor area by multiplying the present index figure by the 1914 cost of $1.05, and dividing the product by 100. Thus 186 × $1.05 = 195; and dividing by 100, the cost on July 1st of this year would be $1.95 per sq. ft. of floor area.

Another interesting chart is shown on page 19, giving the proportions of labor and material costs going into the work. The photograph is an illustration of the building on which the index is based.

Principal Chart Every Three Months

Through the courtesy of the Aberthaw Company this chart will be reproduced at 3-month intervals for the information of engineers, contractors, architects and other interested readers. The July 1st index figure of 186 represents a decline of 6 points since January 1st. It is highly improbable that the decline can continue much farther, inasmuch as on July 1st materials were being bought considerably under the market, and contractors and subcontractors were taking contracts at cost in order to keep their organizations at work. It is believed that a very slight rise in the volume of building construction would cause prices to stiffen.

Concrete Bathtubs Turned Out by Railroad Shop

Satisfactory bathtubs for use in the bathrooms of railroad observation cars were turned out recently by the Union Pacific shops at Omaha, Nebraska.

A wooden mold and a core in section are used, according to the *Omaha News-Bee*. The tubs are cast in one piece with wire netting reinforcement. The mix consisted of white cement and sand. Twelve hours after casting the units are removed and glazed with a cement and water mix. They are then allowed to stand for 24 hours and after this period of time filled with water and cured for 72 hours. The tubs are then drained, dried, sandpapered smooth, and finished in white.

Rail Steel Bar Association Holds 39th General Session

Members of the Rail Steel Bar Association met at Hamilton, Ontario, August 7th and 8th, in their 39th annual general session, to discuss and act on several important problems of production and marketing policies. The program, in addition to the technical and business sessions, included a study and inspection of the plant of a member Canadian mill.

The meeting was an extra session of the association, which customarily meets semi-annually.

Light-Weight Floors and Concrete Units in Office Building

New Lincoln Tower at Fort Wayne Has Light-Weight Floor Panels—Haydite Back-up Units and Roofing Slabs Are Other Structural Features—100,000 Concrete Units Sold at Price Higher Than Competing Material—Steel Frame is Encased in Concrete

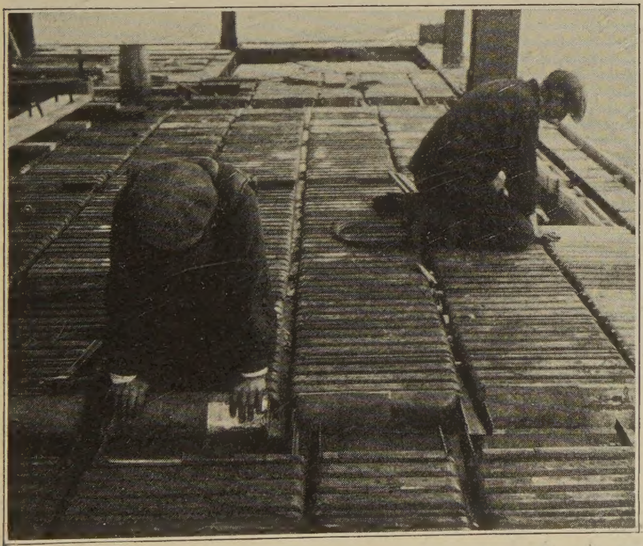
THE Lincoln National Bank and Trust Company Building, a 23-story structure approaching completion in Fort Wayne, Indiana, has several interesting modern features incorporated in its structural parts. One feature is its light-weight floor panel construction, consisting of a steel deck covered with a concrete slab. Another is the use of 100,000 light-weight concrete units in the back-up of the exterior walls, which were sold at a higher price than competing materials would have cost. A third feature may be seen in the light-weight concrete roofing slabs.

The Building

The main body of this building, known locally by the more convenient name of "Lincoln Tower," is 150 by 85 feet in plan, reducing to 58 by 55 feet in the tower. The structural frame is of steel, with all columns and girders in the exterior walls encased in concrete, while above the eighth floor level the interior columns and girders are similarly encased. Below the eighth floor the interior columns and girders are fireproofed with tile units.

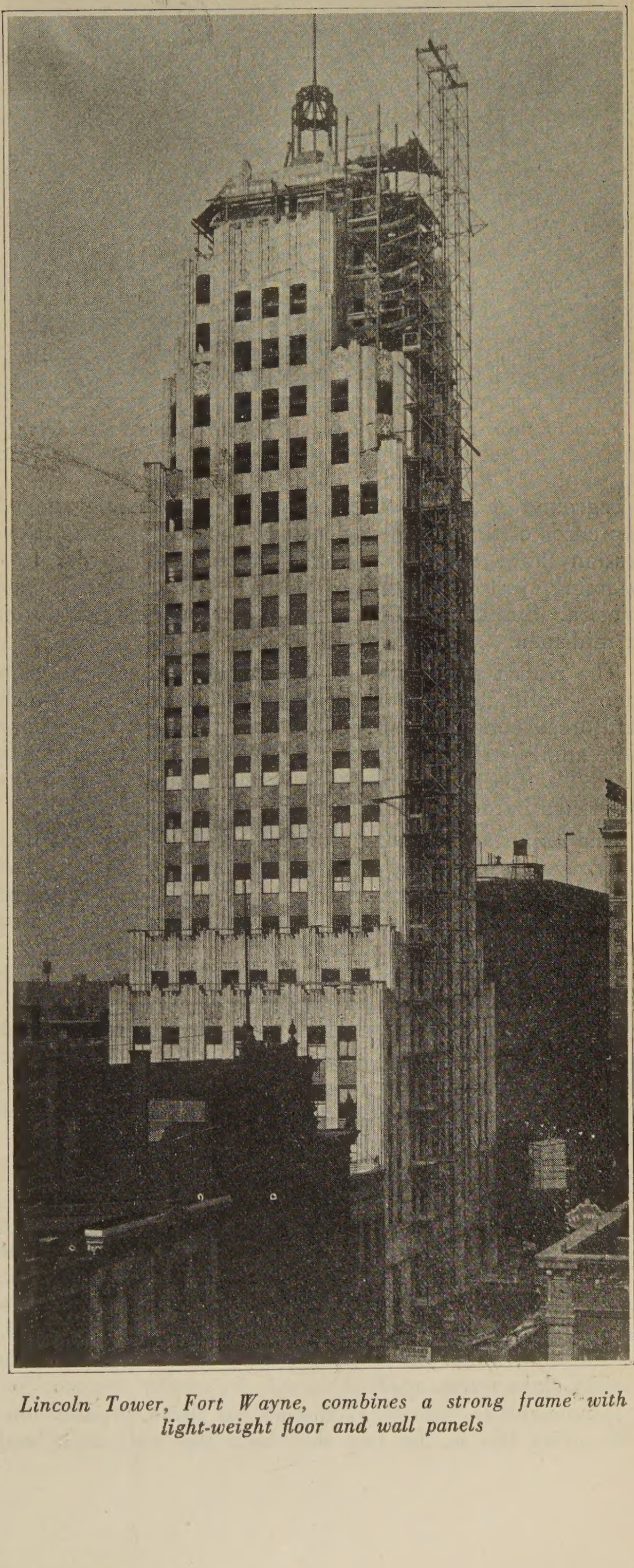
Floor of Steel Deck and Concrete Slab

The new type of floor panel, known as the rivet-grip steel deck construction, is shown quite clearly in two of the illustrations. It contains several features that constitute notable advances in this general type.



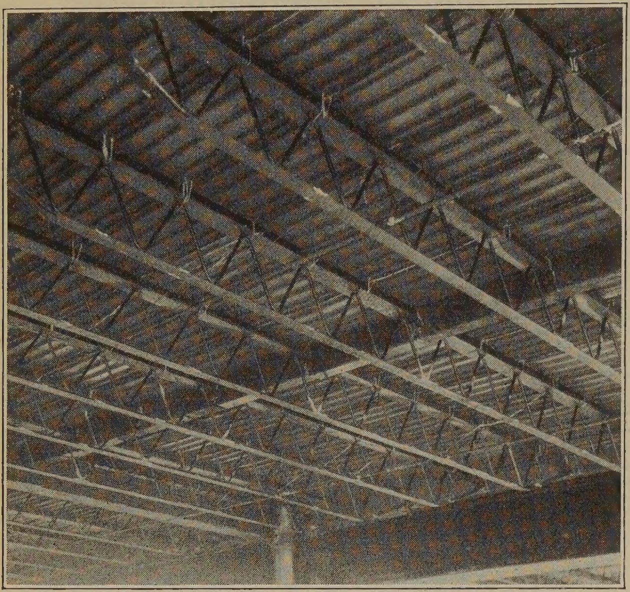
Placing ribbed steel pans which serve also as forms for concrete slab

The supporting members of the floor panel are steel bar joists, placed in the usual way on the principal girders of the structural frame—steel girders in this instance—and anchored at the ends. At mid-span, however, a rein-



Lincoln Tower, Fort Wayne, combines a strong frame with light-weight floor and wall panels forced concrete bridging beam supplies a much higher degree of lateral rigidity than is possible without this feature. This bridging beam is shown clearly in the view of the floor panel from below.

The upper cords of the steel joists are channel-shaped, to provide anchorage for the solid ribbed interlocking steel pans placed upon them. One of the illustrations shows a crew of two men placing these steel pans. In the foreground of that picture the ends of the channel-shaped top cords of the steel joists may be seen. The same illustration shows the special steel form for the girder fireproofing, just in front of the workman closest to the camera. Similar forms are used for the bridging beam at mid-span.



View of floor panel from below. Note the concrete bridging beam at mid-span

The ribbed steel pans are of 20-gauge metal and provide a solid, leak-proof decking or form for the 3-inch reinforced concrete slab placed over the deck. The pans were amply strong to support the usual construction loads as well as the freshly placed concrete floor slab, until the latter had hardened enough to take a part of the loads.

One important advantage of this solid decking was that workmen could walk over it at will, as soon as the pans were placed. Furthermore, the solid decking prevented leakage of mortar when the slab was concreted. It also prevented drying out of the concrete from underneath.

The concrete slab was reinforced with wire mesh. The ceiling is of metal lath and plaster.

Figuring the weight of the joists and the steel pans at an average of 6 lb. per sq. ft., the ceiling at 10 lb. and the concrete slab at 36 lb., the estimated weight of the structural part of the floor, including the ceiling but not the floor finish, is 52 lb. per sq. ft.

100,000 Haydite Concrete Back-Up Units

The exterior walls throughout the entire building are backed up with haydite concrete building units, about 100,000 having been required. Most of the units are the standard 8 by 8 by 16-inch size, though some half units (4 by 8 by 16-inch) and some special sizes were required. In addition, about 5,000 square feet of haydite concrete roofing slabs were supplied.

A noteworthy feature of the use of these haydite concrete units lies in the fact that both the wall units and the roofing slabs were manufactured locally, the wall units by the Acker Cement Products and Supply Co., and the roofing slabs by the Federal Tile Roofing Co.

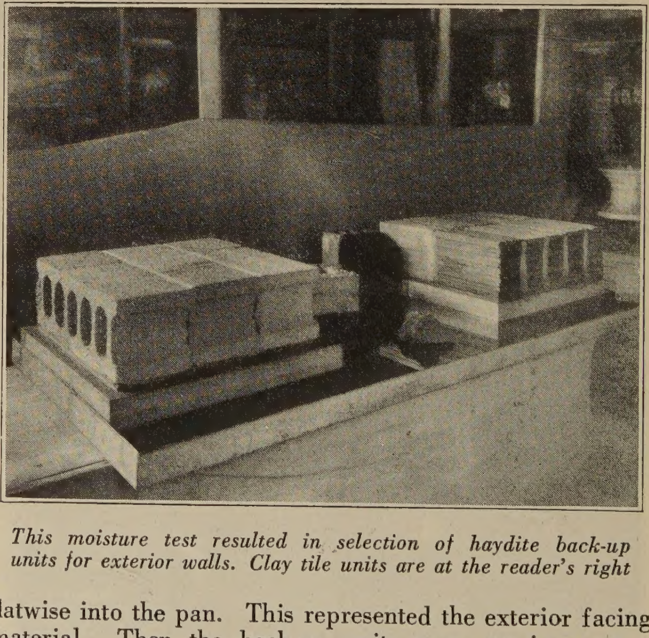
Haydite concrete units were not new in Fort Wayne at the time when structural materials for the Lincoln Tower were being selected by the architect, A. M. Strauss, of that city. This architect had not previously specified them in an important structure, but other Fort Wayne architects had done so. For instance, 20,000 units had been used in a school building, 17,000 in an office building, 15,000 in a church, 15,000 in one industrial office building and 8,000 in another. Smaller quantities had been employed both in Fort Wayne and in surrounding towns, in school buildings, commercial and industrial buildings.

Testing the Units for Quality

In view of the facts just stated, the architect of the Lincoln Tower studied the light-weight concrete units with an open mind. On the other side of the balance was the fact that clay tile would cost less. In consequence, he desired dependable assurance that if his client was to pay a higher price he would also obtain higher quality.

In the course of a number of conferences between the architect, the owners, and the manufacturer of the light-weight concrete units, the conclusion was reached that an absorption test would serve best as a comparison of quality. Accordingly, a method of test was devised with the view of creating conditions closely approaching actual conditions of service in the exterior walls of a building.

One of the illustrations shows the absorption test in progress, and it shows clearly the nature of the test and the test specimens themselves. The test specimens, it will be seen, consist of specimens of wall construction, such as the architect had planned for this building, laying flat in a broad and shallow pan of water. The haydite wall section is on the left and the clay tile section on the right. In each case a 4-inch slab of Indiana limestone was placed flatwise into the pan. This represented the exterior facing material. Then the back-up units were set in mortar, with the thickness of mortar joints between units and the mortar space between the back-up units and the limestone exactly as designated in the architect's specifications for the building.



This moisture test resulted in selection of haydite back-up units for exterior walls. Clay tile units are at the reader's right

On October 11th, 1929, the pan was filled with water to a depth of two inches, and this depth was maintained during the test period. The photograph from which the illustration is made was taken on February 13th, 1930, more than four months later. Long before that time the moisture from the water in the pan had penetrated both slabs of limestone, but from that point upward there was a different story to tell. The moisture had continued to penetrate the clay tile, and made rather rapid progress to practically the full height of the tile, stopping at a level about even with the bottom of the uppermost shell. There the penetration remained stationary during the rest of the test period.

In the haydite units, in contrast, the penetration of moisture had proceeded very slowly, and after four months (when the photograph was taken) the penetration had extended only from an inch to an inch and a half. In no case had it extended completely through the first shell.

Haydite back-up units in exterior walls of Lincoln Tower

The comparative results of the test convinced the architect and the building committee that in these light-weight concrete units they would have exterior walls that would permit no penetration of moisture during a driving rain. The concrete back-up units were accordingly selected, in spite of the higher price involved. One of the interior views shows these units in place in the exterior wall, before the plaster was applied.

Acknowledgments

F. W. Tielker is president, and Russell Acker is vice-president and general manager of the Acker Cement Products and Supply Co., of Fort Wayne, manufacturers of the light-weight concrete back-up units. The haydite used in the units was manufactured at Danville, Ill. The floor joists and steel deck pans were made by the Rivet-Grip Steel Co., of Cleveland. As previously stated, the architect of the Lincoln Tower is A. M. Strauss, of Fort Wayne, and the general contractor is the Buesching-Hargerman Company, of the same city.

New Books and Pamphlets

Masonry Structures

The Design of Masonry Structures and Foundations. By Clement C. Williams. Illustrated. Cloth, 6 by 9 inches, 603 pages. Second edition, revised and enlarged. Published by McGraw-Hill Book Co., Inc., New York. Price $5.00.

This second edition exceeds the first edition, which appeared in 1922, by about 50 pages. New material has been added on subjects wherein more recent developments have been most pronounced, such as in the treatment of plain concrete, the design of arch dams, and the design and construction of foundation work in general. The chapter on retaining walls has been rewritten to include a simpler method of design than the more commonly used method employed in the first edition. This book will serve both as a classroom text and as a reference book for designers and construction superintendents.

Chemical Yearbook

Achema Jahrbuch—1928-1930. Edited in association with scientific and technical experts by Dr. Max Buchner. Paper cover, 6 by 8 inches, 260 pages. Price 10 marks.

This yearbook is one of a succession of editions written for the information of visitors to the annual International Exhibition of Chemical Apparatus, held this year in Frankfort am Main, in June. Apart from this, the book contains much information on the development of chemical apparatus, of particular value to industrial chemists. A limited number of copies are sent free of charge to persons interested in the subject, on receipt of requests accompanied by two international postage coupons.

Some Writers on Lime and Cement

Some Writers on Lime and Cement. By Charles Spackman. Published by W. Heffer & Sons, Ltd., Cambridge, England. Cloth, 5½ by 8½ inches, 287 pages. Price, 15 shillings, net.

This is a valuable and interesting reference book, inasmuch as it lists no less than 292 writers on lime and cement, from Marcus Porcius Cato down to the present day. Under the name of each writer there is a brief description of his work, including descriptions of his most important published papers, books and reports. The book has both a subject index and an author index.

Swimming Pool Information

Swimming Pools is the title of a new 32-page booklet issued by the Portland Cement Association.

It deals with practically all phases of the planning, location, construction and operation of indoor and outdoor pools, both publicly and privately owned. Concrete specifications are included.

Twenty-five types, of varying treatment, are illustrated. There are five line drawings.

Wheelbarrow Standards

Simplified Practice Recommendation R105-29. Prepared by the Bureau of Standards, U. S. Department of Commerce. Copies from Government Printing Office, Washington, D. C., at 10 cents each.

According to this publication on wheelbarrow standards, the recommendation became effective in September, 1929. The history of the project is given, followed by the standing committee and its organization and duties.

Cement Directory

The American Cement Directory. Published by the Bradley Pulverizer Company, Boston, Mass. Price $3.00.

The new edition of this comprehensive directory listing the cement plants of America, their offices and officials and other relevant information, came off the press recently and copies are now available.

Paving Contracts and Contemplated Construction at High Figures

Concrete Pavement Awards More Than Hundred Million Square Yards — Construction Contracts Are Disappointing, But Much Work Is Contemplated

The month of July maintained the pace set by previous months in the matter of contracts awarded for concrete highway pavements, with a liberal excess over July, 1929. In contrast, the month was disappointing in the volume of general construction contracts, for it failed to follow up the fine showing made in June.

Big Yardage of Concrete Pavements

Concrete highway pavements for which contracts were awarded in July amounted to 12,719,601 sq. yd., compared with 11,344,047 sq. yd. in July, 1929. Street and alley pavement awards were less than last year. For the first seven months of the year, and the corresponding period of 1929, the concrete paving awards stand as follows:

SQ. YD. OF CONCRETE PAVEMENTS AWARDED

	In First Seven Months of Year	
	1929	1930
Roads	62,190,761	77,711,488
Streets	27,215,672	20,960,714
Alleys	2,098,079	1,564,132
Totals	91,504,512	100,236,334

Construction Contracts Are Lower

Construction contracts awarded in the 37 states east of the Rocky Mountains are reported as follows by the F. W. Dodge Corporation:

CONSTRUCTION CONTRACTS IN JULY

	1929	1930
Buildings	$457,889,400	$252,662,100
Public works and public utilities	194,546,700	114,866,300
Totals	$652,436,100	$367,528,400

For the first seven months of 1930 construction contracts amounted to $3,005,541,700, compared with $3,684,242,900 in the first seven months of 1929.

Contemplated Construction Gains

The Dodge organization reported contemplated construction work in July at a total of $559,477,700, a substantial gain over the amount of $480,212,100 reported in July of last year.

Testing the Dryness of a New Concrete Floor

If new concrete or unsuspended floors are not thoroughly dried out, there is a simple yet dependable test by which the presence of moisture can be determined. This test has been developed by the Armstrong Cork Company in connection with the laying of corkbrick, cork tile and linoleum coverings over new concrete floors, but they are equally practical wherever it is essential, the floor being dried out before a final covering is put on or a waterproofing process applied.

The test to detect moisture in sub-floors is as follows: Place on a two-inch watch crystal a quarter-teaspoonful of anhydrous calcium chloride, which can be readily obtained at any drug-store. Set the crystal on the floor and cover it with a five-inch clock crystal, imbedding the edges of this cover in soft putty spread in a five-inch circle around the watch crystal. It is important to have the edges of the glass well imbedded in the putty to prevent any air reaching the calcium chloride. Within twenty-four hours any dampness in the floor will make the calcium chloride wet. If there is a considerable amount of moisture present, the chemical will dissolve.

Sixth International Road Congress Scheduled for Washington

The Sixth International Road Congress has been scheduled to meet in Washington from October 6th to 11th, at the invitation of the United States Government. The purpose of this congress is that of continuing the studies and discussions of progress in highway construction and research initiated at the first congress, held in Paris in 1908. The second congress was held in Brussels in 1910, the third in London in 1913, the fourth in Seville in 1923, and the fifth in Milan in 1926. The forthcoming meeting is the first for the western hemisphere.

J. Truman Thompson, professor of civil engineering in Johns Hopkins University and connected in a consulting capacity with the United States Bureau of Public Roads, has been appointed manager of the sixth congress.

Simultaneously with the congress, a road machinery and materials exhibition and demonstration will be held by the American Road Builders Association, at the Washington Auditorium.

Subjects to come before the congress have been classed in two sections—construction and maintenance, and traffic and administration. Papers to be presented in the first section will include those dealing with the results obtained by the use of cement, and the construction of roads in colonies and undeveloped regions.

The first plenary session and opening of the congress will take place in the afternoon of October 6th, at Constitution Hall. Section meetings will begin the following morning, followed by the official opening of the Road Builders association exposition. Section meetings and an official reception will occupy the entire following day.

The morning of October 9th is scheduled for section meetings, and the afternoon for a second plenary session for discussion of conclusions, followed by the American Organizing Commission dinner.

An inspection trip to the experiment station of the United States Bureau of Public Roads at Arlington, Va., will be made the morning of the following day, and the official closing of the congress and reception will take place in the evening.

Coming Conventions

Sept. 29-Oct. 4—Pacific Coast Building Officials' Conference, ninth annual meeting. Virginia Hotel, Long Beach, Calif.

October 6-11—Sixth International Road Congress. Constitution Hall, Washington. D. C.

October 20-22—Concrete Reinforcing Steel Institute, semi-annual meeting. Briarcliff Lodge, Westchester County, New York.

January 10-16—American Road Builders Association, convention and road show, St. Louis, Mo.

~ EDITORIAL ~

This Is the Time to Build

ALL experienced and well-informed architects and contractors will understand the meaning of the story told on the Aberthaw chart showing changes in the cost of building, printed elsewhere in this issue.

The violent fluctuations in building costs for a few years following the war, the secondary peak established in 1923, the gradual and scarcely perceptible decline for the next four years and the final stabilization in 1927, are all matters of history.

The part of the story in which our present interest lies is the period of stabilized costs from the latter part of 1927 to the beginning of 1930, and the decline since the first of the present year.

The cost of a reinforced concrete building is now perceptibly lower than the same building would have cost during that period of stabilization just mentioned. We all know this to be a fact, without ever having seen the chart; but the chart tells us the extent of the decline since the first of this year.

What is more, we have a rather clear understanding of the reason for this recent decline. Building costs are lower now than on January 1st because materials are being bought at prices considerably below the market quotations, and because many contractors and sub-contractors are taking contracts at little or no profit, for the sake of keeping their organizations and equipment at work. Skilled labor is cheaper because it is more efficient, unskilled labor rates are lower in some sections, and the labor turnover is less.

Precisely similar conditions have existed during corresponding periods in times past; but never have such conditions continued for any great length of time. There is no reason to expect the story to be different in this instance.

What will happen when the inevitable pick-up in building construction gets under way? The answer is simple. It will be what always has happened. Prices will stiffen, because contractors will again include a margin of profit in their bids, and material dealers will no longer accept sales at cost. Construction costs will probably return to the stabilized levels of 1928 and 1929.

With these considerations in mind, and with the facts of past history in hand, it should not be a difficult matter for an architect to convince a prospective owner that this is the time to build.

Showing the Way to Public Officials

MUCH was heard during the early months of this year about the importance of aiding public officials in getting started on construction work which for some reason had been delayed.

Vigilance in this respect is no less imperative now, as a report from a southern county demonstrates. A field engineer of the Portland Cement Association appeared before a group of officials of this county, presented a map and explained a concise plan of financing whereby the state would share the cost of paving certain roads. This resulted in action being taken on 33 miles of concrete road projects which had been lying dormant.

Making Fire Prevention Week Worth While

THE annual fire prevention week, scheduled for October 5th to 11th, inclusive, may mean much or little to the concrete products and concrete construction industries, depending largely on the extent and nature of the part played on local programs by products manufacturers and the concrete construction groups.

Much depends also on the extent to which these same men have been emphasizing the fire-resistive character of concrete all the year round.

Getting down to the form of participation, there are few phases of fire prevention that are as easily comprehended by the public as the ability of reinforced concrete floors and concrete masonry walls and partitions to prevent the spread of fire.

Fire prevention week can be made an aid to the concrete construction industry if proper thought and effort are devoted to the presentation of the fire-resistive qualities of concrete and concrete masonry. The best method for impressing these qualities on the public mind can be determined if representatives of the concrete construction industry will get together now and make their plans.

When Paving Stops This Fall

CONCRETE paving work can not continue throughout the winter. The cost of protecting work of this form would be prohibitive. As in former years, paving must stop when cold weather approaches.

The area of concrete roads, streets and alleys for which contracts were awarded since January 1st of this year passed 100,000,000 square yards on August 2nd. This is about 10 per cent in excess of last year's record at the corresponding date.

Because of this exceptionally large volume of concrete paving, the effect of its cessation will be greater than ever. Architects and engineers can help themselves and at the same time soften this effect if they will push forward every possible project to the actual construction stage this fall and winter.

Current Activities of Organized Groups

Many knotty problems pertaining to cement and concrete are either in course of solution or recently completed by organized societies or smaller groups. The busy reader may keep himself informed by watching these items.

Proposed Government Specification for Portland Cement

THE Federal Specifications Board of the United States Bureau of Standards, an inter-departmental board for the co-ordination of government specifications, is adopting and promulgating purchase specifications for various building materials, including portland cement and hydrated lime.

The proposed specification for portland cement has been submitted to representative manufacturers of cement for comment and criticism. On the basis of criticisms received the final draft will be written and the specifications will be published.

Both in arrangement and in phraseology the proposed specification is in close conformity with the A. S. T. M. standard specifications for portland cement. The newly adopted A. S. T. M. mortar tensile strength requirements of 275 and 350 lb. per sq. in. at ages of 7 and 28 days, respectively, are included in the proposed government specification.

A. R. E. A. Continues Its Studies of Concrete

THREE OF the standing committees (Committees VI, VII and VIII) of the American Railway Engineering Association are engaged actively in the study of subjects pertaining to some phase of the design, construction or repair of concrete structures. A list of subjects under investigation and the committees dealing with them will be found in the paragraphs that follow.

Waterproofing and Dampproofing. The study of the waterproofing and dampproofing of existing buildings where leakage or dampness has developed is being continued by Committee VI under the chairmanship of A. L. Sparks, architect for the Missouri-Kansas-Texas Ry., St. Louis, Mo. Committee VI is co-ordinating this work with that of Committee VIII, which has also assembled considerable data on the waterproofing of concrete and masonry structures.

Specifications for Concrete Work. Committee VI is continuing with its work of perfecting a specification for concrete used in railway buildings, while Committee VIII, under the chairmanship of C. P. Richardson, engineer of track elevation, C. R. I. & P. Ry., Chicago, is preparing specifications for foundations, including excavation, cofferdams, piling and foundation concrete work.

Repairing Deteriorating Concrete. The determination of effective methods of repairing deteriorating concrete is a new subject assigned to Committee VIII. The committee is devoting a considerable part of its time to that work, in the expectation of developing methods of procedure under the various conditions encountered.

Principles of Design. Committee VIII, which last year developed formulas for the design of flat slabs under moving railway loads (see June, 1930, issue of CONCRETE, page 48) is continuing its studies of the principles of design and the art of making concrete. This work consists largely of efforts to improve the reports previously issued by this committee covering the same subjects. Committee VIII was, in fact, one of the first groups representing a national engineering organization to put the water-cement ratio law into practical use. In 1927 the committee issued its first report in which that law was incorporated, and each year since then it has contributed valuable additions to the science and art of making good concrete.

Concrete Piles. Investigation of the relative merits of concrete piles and treated wooden piles is a new subject assigned to Committee VII, acting under the chairmanship of H. Austill, bridge engineer, Mobile & Ohio R. R., St. Louis. The committee is now engaged in its investigations and in the assembling of data for study.

Standard Dimensions and Allowable Loads for Steel Joists

REPRESENTATIVES of the steel joist industry, at a general conference held recently under the auspices of the Division of Simplified Practice of the Bureau of Standards, Department of Commerce, proposed and approved a simplified practice recommendation covering dimensions and allowable loads per linear foot of open web steel joists.

In accordance with the usual practice of the division, mimeographed copies of a summary report of this conference have been mailed to all interests for their consideration and signed acceptance. The recommendation, if adopted, is to become effective October 1st, 1930.

Exhibit of Mineral Resources at Western Society of Engineers

DURING the first two weeks of September the Western Society of Engineers will hold an exhibit of the mineral resources of Illinois at the society's rooms at 205 W. Wacker Drive, Chicago.

Exhibits will include cement rock, crushed stone, gravel, ordinary sands, glass sands, oil shales, coal, zinc ore, and in fact all products of quarries, mines and pits.

The exhibit is made possible through the co-operation of the State Geological Survey.

1930 Book of A. S. T. M. Standards

THE 1930 issue of the Book of A. S. T. M. Standards, again printed in two volumes and comprising a total of about 2,300 pages, is expected to be ready for distribution about October 15th.

Conforming to previous practice, Part I will contain standards relating to metals and Part II will cover non-metallic materials. The total number of standards will be 426, printed in their latest revised form.

The Book of A. S. T. M. Tentative Standards will, as usual, be printed in a separate volume and is also expected to come from the press about October 15th. It will contain the latest revisions of 152 tentative standards of the society.

Welded Concrete Masonry Back-Up Walls in Apartment Building

Fundamental Change in Masonry Construction Practice —Cement Gun Fills Open Joints and Coats Faces of Concrete Masonry Units Laid "Dry"—Welds Wall Into Monolithic Mass — Construction Procedure Described and Illustrated

By LOUIS H. DOANE
Sales Engineer, The Covell Corporation, Philadelphia, Pa.

THE use of Weldcrete masonry construction in the 10-story Riviera Apartments at Atlantic City is a representative example of the first important innovation in the basic principles and practices of masonry construction in ten thousand years or more. The sizes and shapes of masonry units have changed, but the method of assembling them is as old as the first stone or brick habitation of the human race. This innovation in method is in the application of the mortar.

New Masonry Construction Described

In Weldcrete construction, the mortar is shot into the joints by means of a cement gun operated by compressed air, from the face of the laid-up wall.

This new method of masonry construction has taken two of the youngest materials of building construction—cinder concrete units and gunite—and combined them to produce a wall containing the advantages of both, as well as certain features common only to their joint use.

This composite wall of two supplementary materials—so positively welded together by impact that wall strength in many cases becomes greater than unit strength—is known as Weldcrete masonry.

For the first time in the world's history, the writer believes, a set-up wall has been completely unified, both materially, by reason of the fusion of the "welded" joint over the hand-laid joint, and chemically, because of the natural affinity between the wall unit and mortar materials.

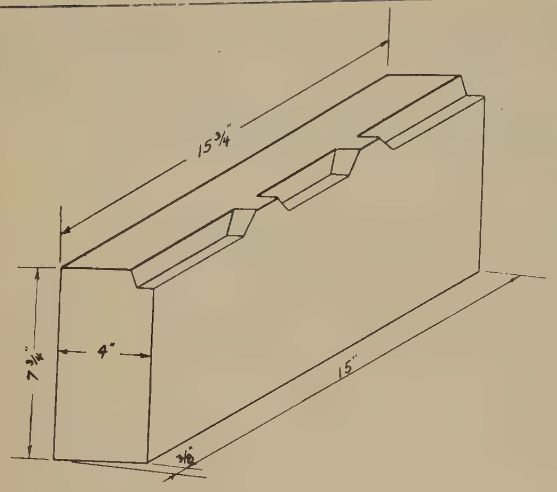
Earl D. Covell, vice-president and chief engineer of the Covell Corporation, and the inventor of Weldcrete masonry, in his original conception of the idea had first to find a precast masonry unit which would be uniformly straight, square and true. The unit which most closely approached the ideal in this respect was the concrete block. A cinder concrete unit has been adopted for this method of construction because of its high insulating value, resistance to fire, and its lightness. The only exception is in the construction of heavy load-bearing walls, where concrete units of gravel, crushed stone or other similar aggregates are used.

The Construction Procedure

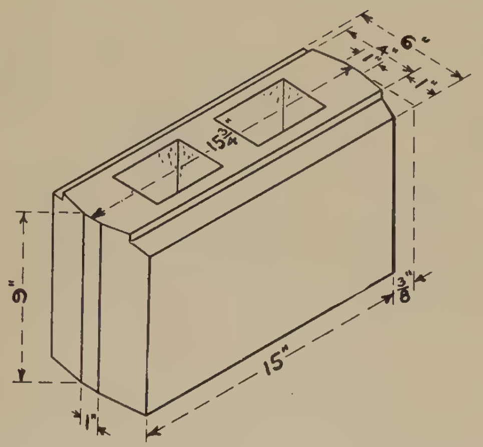
Weldcrete masonry walls consist fundamentally of two gunite coats, each not less than ½ inch thick, separated by a wall of hollow or solid cinder concrete units, except in the case of heavy load-bearing walls, as previously explained. The joints between the units, which are of different shapes for different types of walls (Figure 2), are also filled with gunite. One or both of the coats of "gunite" is shot on the wall itself, depending on the type of construction. A 1:3 mix is used in all of the gunite work done in conjunction with insured Weldcrete masonry. The insurance feature is explained later. The actual construction is performed by the same artisans as in the hand-laid mortar joint wall. The composite wall construction in the Riviera Apartments (Figure 1) will be described as an illustration of the construction procedure.

Brick masons built the 4-inch face brick wall with hand-placed mortar, either to scaffold height, sill height, or header course, depending on field details. The back of this face brick was parged with a ½-inch coat of "gunite" by a brick mason (Figure 3). The dry cinder units were then laid against the parge coat by masons (Figure 4), and the gunite joints were shot by a member of the same trade (Figure 5). The gunite base coat on the face of the wall was then shot by a plasterer, who screeded and prepared it for the white finish coat of plaster (Figure 6).

Figure 1. Riviera Apartments, Atlantic City, N. J.



Single Ribbon, Single Slope, Face Barrier End



Double Ribbon, Double Slope, Center Barrier End

Figure 2. Typical concrete units used in new type of masonry

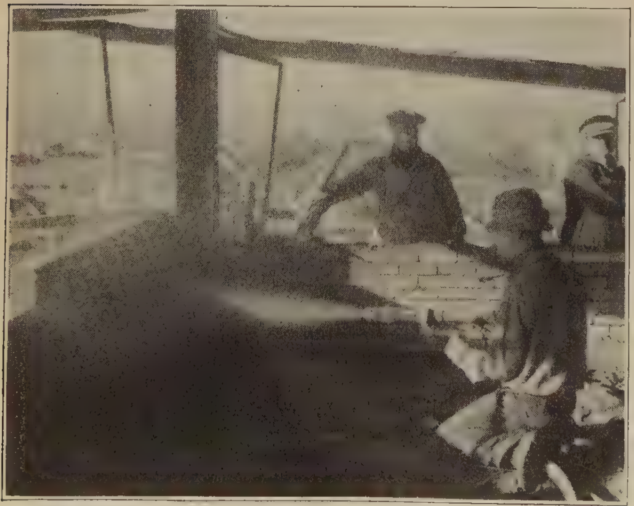


Figure 3. Shooting the parging coat of gunite against inside face of brick veneer

The architect of the Riviera Apartments was Benjamin Brown, and the builders were the Herbert V. Realty Co.

Different Types of Wall

Three principal types constitute the types of wall construction by this new method. First, there is the wall having a gunite exterior finish, similar in appearance to stucco. In this type the body of the wall consists entirely of concrete units, and the exterior and interior coats of gunite are both shot on the wall itself.

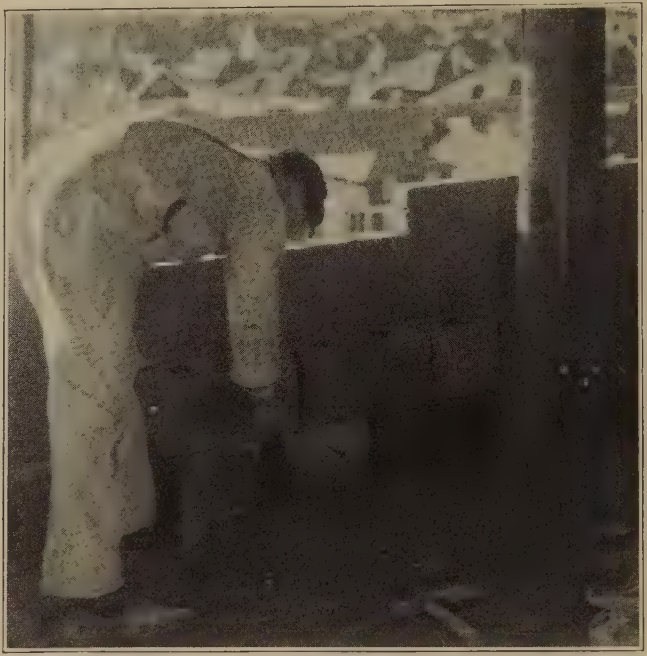


Figure 4. Laying up the "dry" masonry back-up of concrete units

Another type is the composite wall, illustrated in Figure 7, in which the exterior facing or veneer is of cast stone,

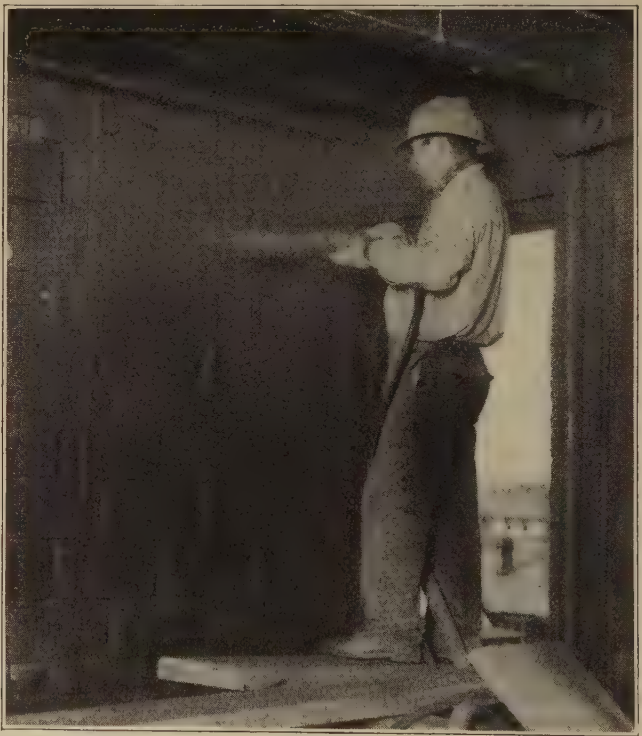


Figure 5. Gunite fills the mortar joints and builds up a coating or plaster base

natural cut stone, face brick or similar material, and hollow cinder concrete building units are employed as back-up. This is the type of wall in the Riviera Apartments, previously described. As stated, the facing or veneer masonry is laid up by the old hand-placing method, after which the back face of the veneer is parged with a ½-inch coat of gunite. The dry concrete units are then laid up against the parge coat. The joints on the inner face of the wall are filled with gunite, this process being continued until a ½-inch coat of gunite covers the entire interior face.

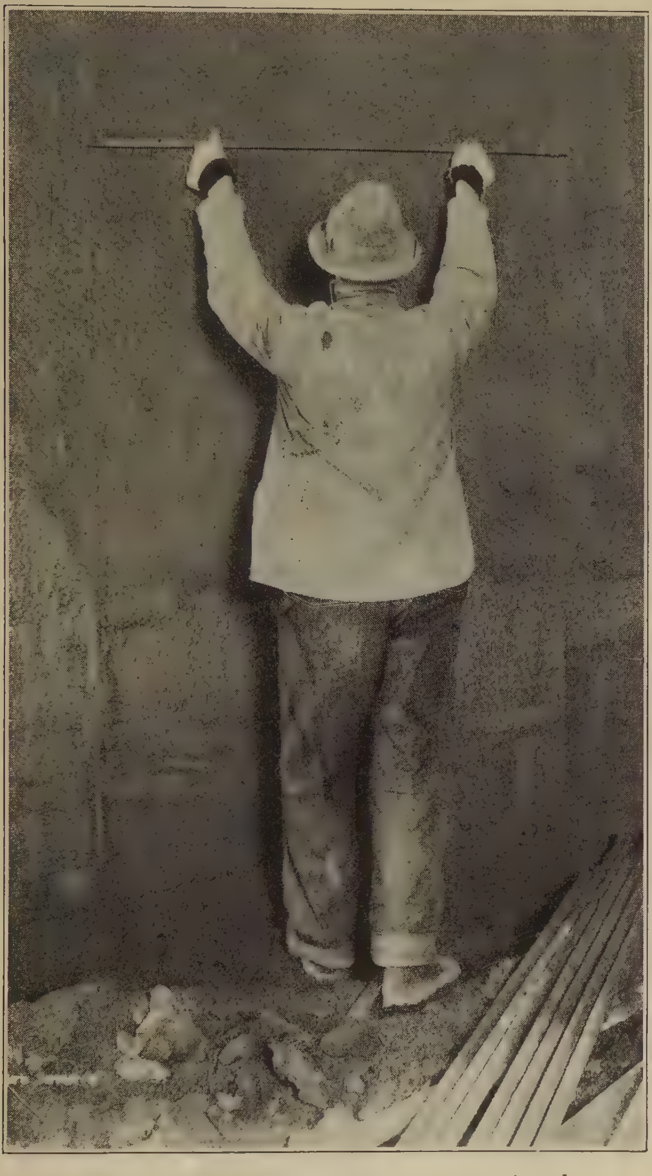


Figure 6. Screeding off the gunite coat to receive plaster finish coat

A third type consists of furring masonry, in which the construction procedure is similar to that of the composite wall, just described, the only difference being in the lesser thickness of the furring as compared with the back-up of the composite wall.

Some Advantages

An important advantage of this form of masonry may be seen by considering the waterproofing qualities of the walls in the Riviera Apartments. Figures 3 and 4 show this feature most clearly. The parging coat of dense gunite on the back of the facing or veneer serves as an effective barrier against the passage of moisture through the wall. For the same reason the danger of the appearance of efflorescence is reduced, since the leaching process that produces efflorescence can not extend beyond the parging coat, and probably not even that far.

Wall efficiency is a term employed to denote the relation between the unit strength of a masonry wall and the unit strength of the individual masonry units that make up the wall. Tests conducted at the University of Pennsylvania under the direction of Prof. H. C. Berry indicated a wall efficiency actually greater than 100 per cent, because some of the "welded" walls and wallettes tested were slightly stronger than the individual concrete units employed. This was doubtless due to the monolithic nature of the completed construction.

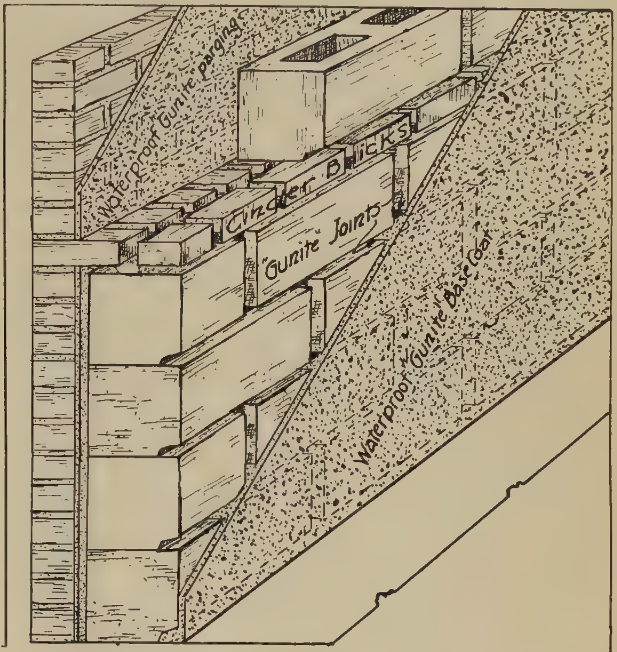


Figure 7. Detail of composite wall of cinder units and gunite

How This Masonry is Insured

The Covell Corporation insures this masonry against the seepage of water or the passage of moisture through exterior walls, for a period of ten years, without additional cost to the owner. This blanket insurance is carried with the National Union Fire Insurance Co.

Cost Data

Comparative generalizations are all that can be discussed in connection with costs, because of the influence of local labor and material conditions in different sections of the country. In general, Weldcrete masonry will cost approximately the same as dampproofed brick walls of equal thickness. It is substantially cheaper than the construction usually specified for severe exposures, which consists of face brick, hand parging between the face brick and the back-up material, asphaltic dampproofing on the interior face of the back-up, an air space and metal lath and plaster, split tile or cinder block furring. The cost of Weldcrete is further influenced by the size of the project and sizes and spacing of openings. The standard Straub-Covell cinder units are 4, 6, and 8 inches thick, 7¾ inches high and 16 inches long, with half blocks 8 inches long. Careful consideration of these sizes in designing openings, sill heights and header courses, appreciably reduces the cost of construction, for the cost of gunite to fill a given space is three or four times that of a cinder concrete unit.

Portland Cement for Masonry Mortars

Pre-hydration of Mortar Recommended to Prevent Shrinkage—Sand Sizes Important—Mixing Proportions, Proposed Specifications and Procedure — Pre-hydrated Mortar Not a Retempered Mortar

By E. Y. BRAGGER
Research Engineer, Medusa Portland Cement Co., Cleveland, Ohio

The greater percentage of masonry mortar is now made with cements other than portland. This writer proposes to remove one objection to portland cement mortar, and in this discussion he sets forth a procedure that will eliminate shrinkage. We believe a full discussion of this subject will lead to a greater use of portland cement in masonry mortars, and to that end we invite contributions from others who have made a special study of the problem—The Editors.

ONE of the early objections to portland cement mortars, stuccos and plasters was shrinkage cracks, due largely to proportions too rich in cement. These difficulties have been largely overcome by adopting leaner mixes and using carefully selected and properly graded sands. There is, however, another important factor that enters into the activity of portland cement mortar, and that is hydration.

Most specifications read: "Portland cement mortar or stucco that has been mixed for a period longer than thirty minutes shall not be used." The question is whether we are in error when imposing this restriction. We know that just as long as portland cement continues to take up water through the process of hydration, and sands or other aggregates during saturation, we are bound to get activity in the mortar mix.

Mortar must be delivered to the mason or plasterer at a workable consistency which, in most cases, is a flooded mix, but free water in the portland cement mortar or plaster at the time of application will result in trouble. Highly absorbent masonry units will take up the free water necessary for the crystallization of the cement, resulting in a short and sandy condition of the joint. Low absorptive masonry units will cause a floating condition on the mortar bed which in turn allows shrinkage cracks to appear after the mortar has been allowed to dry out.

Use of Coarse Grit in Mortar

The Romans were advanced in the practice of hydration and in many places mortar made by them is still in good condition, as evidenced by the Roman Baths at Bath, England. In damp and humid climates, mortar used on buildings erected several hundred years ago is still in good condition where the walls have been protected from the elements; but where the walls have been exposed, the mortar is soft and full of moisture. In the erection of many of the early English buildings, some of which are still standing, a coarse grit was used in the stone-setting mortar for the apparent purpose of carrying the load, the mortar simply acting as a binder. In those buildings there is but little evidence of shrinkage cracks. In the southeastern part of England, in buildings such as Windsor Castle, Hampton Court, Great Hall, City Wall and Gate at Winchester, the grit used in the mortar is crushed flint, somewhat smaller in size than the mortar joint required. In other parts of England pebbles were used.

Modern Practice Demands Speed

A few decades ago the practice was to build the mortar bed at the site of the work before the foundation trenches were dug, in order to allow sufficient time for hydration or soaking of the mortar. In these modern days when speed is of primary importance the custom is to apply portland cement mortar or plaster while in the most active stage of crystallization, which occurs within thirty minutes after the addition of the water. The modern need is not for a mortar two or three times the strength of the unit to be bonded or the wall to be covered. The present demand is for a lean mortar, composed of true waterproofed portland cement, carefully selected and properly graded aggregates, low in absorption, that will remain as placed with a minimum of expansion and contraction.

Waterproofing Element and Sand Sizes

The correct basic ingredient for all masonry mortars is portland cement, preferably a waterproofed portland cement which consists of an insoluble stearate ground with the clinker in process of manufacture at the mill.

The words "properly graded" should be included in all specifications. It is just as essential to use a sand properly graded in sizes from the 48-mesh screen to fine as it is to use a sand graded in sizes from the ¼-inch mesh to 48. An excess of fines in improperly graded sands passing the 48-mesh screen is frequently the cause of shrinkage cracks, due to the higher water attraction. Not more than 15 per cent nor less than 10 per cent of fines should pass through a 60-mesh screen.

Proportions Recommended

Sand properly graded from ⅛ inch to fine, when used with portland cement, will produce a mortar of high strength in a mixture of 1 part of portland cement to 3 parts of sand. In many cases the sand content may be increased to 3½ or 4 parts, especially where the joints are to be ½ or ⅝ of an inch thick. This will permit the use of 15 per cent of one-quarter inch stone and still produce a workable mortar giving better results.

We must consider the workability of the mortar to be used. The mason needs a mortar that will stick and spread when used on any brick or stone, whether of high or low absorption. The plasterer requires a mortar that will stick and spread without sagging or creeping.

Hydrated lime or lime putty is frequently a valuable admixture to portland cement mortars, but should never be used in excess of 10 per cent by weight or 20 per cent by volume of the portland cement; otherwise trouble will follow because of absorption and shrinkage.

Proposed Specifications

Knowing the activity of portland cement in the early stages of crystallization or hydration, and the resultant effects due to shrinkage cracks of all portland cement mortars or plasters when applied too soon after mixing, it is recommended, except for work to be subjected to hydrostatic pressure, that the following method of mixing be adopted and the results from all angles closely observed:

PORTLAND CEMENT MORTARS, PLASTERS, STUCCO OR GROUT

"All ingredients shall be thoroughly mixed when dry, and sufficient water then added to reach the consistency of damp earth. Allow the mix to hydrate from two to three hours before tempering with additional water sufficient to reach the proper consistency for application."

It will be found that such a mortar possesses great workability. All of the free water has been taken up and the mix has developed into a jellied homogeneous mass with increased plasticity. Expansion through hydration of the portland cement mortar has to a very large degree taken place in the mixing bed rather than in place on the job, thereby overcoming shrinkage cracks in all normal construction.

There will be objections on the part of contractors because of the apparent increase in cost, should this method of mixing portland cement mortar be adopted. It may be granted that on good-sized operations it would be necessary to have two mortar beds with a machine mixer between, gauging the mortar to be used from one while the mix is hydrating in the other. The contractor's gain, to offset this extra labor, will be a larger proportion of sand to every mix, and increased workability.

An Alternate Procedure

Should the above recommendation be found to be impracticable because of the contractor's objections, then it is suggested that the portland cement mortar be mixed to a regular consistency and the application delayed as long as possible up to the three-hour period, providing that the mortar continues to be workable without requiring the addition of more water to the original mix.

This is not a new thought of the writer, but the result of fifteen years of observation, including nine years of practical demonstration of pointing and embedding mortars, plasters and stuccos. This method of mixing has likewise been adopted and successfully used in the prevention of hair cracks on cast stone facing. Several prominent architects have adopted the foregoing paragraph in their specifications and it would be well if the manufacturers of prepared portland cement stucco would follow.

Not a Re-tempered Mortar

Prehydrated portland cement mortar must not be confused with a re-tempered portland cement mortar. The addition of water to the latter, after it has once been mixed to the proper consistency, would be detrimental. Neither should we expect a pre-hydrated mortar to have the quick hardening of a similar mortar that has been mixed and applied within the thirty-minute period so frequently specified. As before stated, we do not very often need a portland cement mortar of quick hardening or high early strength qualities; but we do need a waterproofed portland cement mortar that will not develop shrinkage cracks or crazing. This applies particularly to stone and brick mortars, portland cement stuccos and plasters.

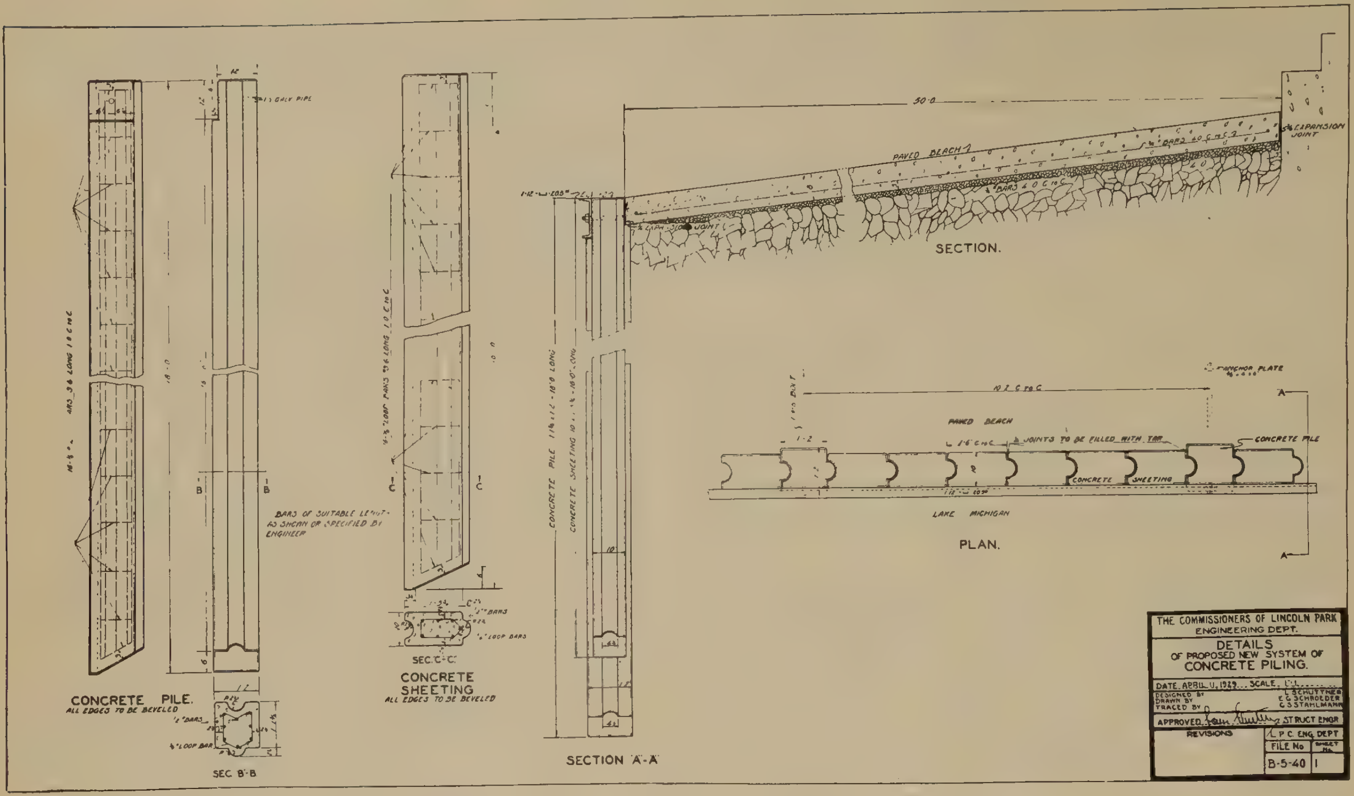
Sheet Piling Saves Lake Shore

Casting of Precast Piles Described—Handling, Transporting and Driving the Piles — Tongue-and-Groove Joints Sealed with Asphalt—Cost Data—Much Valuable Land Reclaimed

LAKE LEVELS some 4 ft. above what had been considered normal caused thousands of dollars damage to lake shore property in Chicago during 1929. The Lincoln Park Board, which is gradually adding to the area of the park by filling in along the lake shore, had roads, driveways, beach pavement and sidewalks destroyed by the wash of the waves. To protect the shore from further damage they have been replacing the old wooden sea wall with a higher, water-tight wall of concrete sheet piling.

Much of the damage was caused by the leakage of water through the spaces between the planks forming the old wooden sea wall. This back-wash carried with it the earth on which the roads and walks were founded, allowing the surfaces to cave in. To prevent similar damage in the future the concrete sheet piling was made water-tight by tongue-and-groove joints sealed with asphalt.

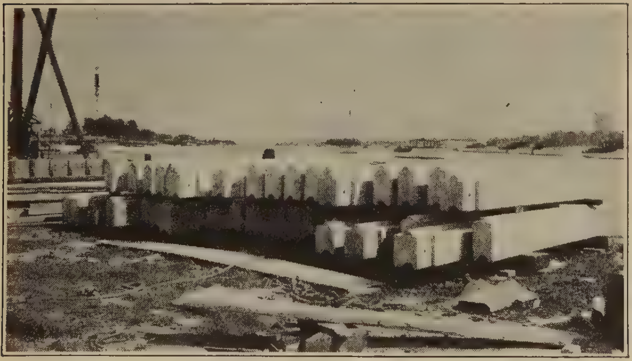
Piles are cast at a central yard. The forms are lined with galvanized metal



Design details of the sheet piling used on Chicago's lake shore

Casting, Handling and Transporting Piles

The piles are precast in a central yard in Lincoln Park by employees of the park. The forms are heavy planks lined with galvanized metal. Two bases are required for each pair of sides so that the sides can be stripped in 24 hours and the pile be left on the base for 48 hours. The sides are held in place on the base by a wooden strip and are kept the correct distance apart at the top by strap iron clamps that can be removed easily. After the forms are removed and while the piles are waiting to be transported to the wall, they are occasionally sprinkled to cure them and so increase their strength and impermeability. The concrete is proportioned 1:2:4.



A tongue in one edge and a groove in the other assures a tight fit and a reasonably water-tight joint

The piles are handled by a crane. A hole is left in one end through which the handling chain can be attached to them without damaging the tongue-and-groove edges. Considerable care is required to prevent breakage in handling, especially of this tongue-and-groove. The piles are carried on barges to their location in the wall.

The new concrete wall is being set a few feet behind the old wooden wall. The piles are lifted from the barge by a crane and set in position between two stringers that hold them in line while they are being driven. Careful placement in the correct position is required to make a tight joint. The pointed end of the pile is beveled all one way and that bevel is set to force the lower end over against the previously driven pile.

The completed wall

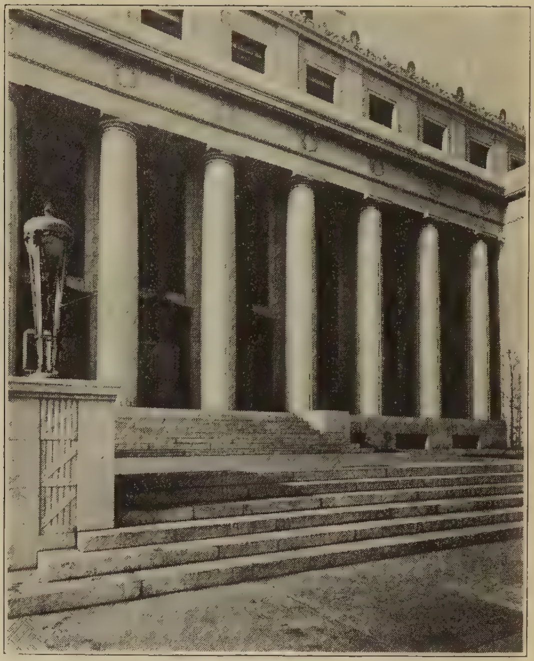
The pile settles several feet from its own weight. Further settlement is secured by running a water jet down along each edge of the pile, and it is then driven the last few feet with a steam hammer.

The piles cost about $8 each and the cost in place in the wall is about $26 per lineal foot of wall.

Hotel Establishes Engineers' Reference Room

A study and reference room for engineers is a unique feature established by Allerton House, a residential hotel at 701 N. Michigan Ave., Chicago. The facilities provided include a reference library covering the various branches of engineering and allied sales branches, more than twenty-five leading engineering magazines, study tables and drawing boards and instruments.

How Architects *Will* Specify Cast Stone



Cast Stone Institute Issues Complete Architectural Specification — Provides for 5,000 lbs. — Condensed Form to Be Available Soon

A COMPLETE architectural specification for cast stone, developed by the Cast Stone Institute in conjunction with the American Concrete Institute, is now available. A condensed form of specification is in course of preparation and will be available shortly.

A manufacturers' specification is also embodied in the report of Committee 704, Cast Stone Standards, presented by title at the 1930 meeting of the American Concrete Institute and published in the May issue of the Institute's *Journal.*

The architectural specification reads as follows:

COMPLETE ARCHITECTURAL SPECIFICATION FOR CAST STONE

General

The work covered by this specification is subject to the provisions of the "General Conditions of the Contract" (Fourth Edition, copyrighted 1925) issued by the American Institute of Architects and the Cast Stone Manufacturer and the Erecting Contractor shall be governed by all the requirements thereunder.

Work Included

This specification covers all labor, materials and services incidental to and including the furnishing and erecting of all cast stone as indicated on the drawings and specified herein.

Division of Work

The Manufacturer shall be responsible for all labor, material, equipment and services necessary for and incidental to providing all cast stone covered by this specification.

The Erecting Contractor shall unload, receipt for, store and erect all cast stone covered by this specification and shall provide and install all anchors for same.

Drawings and Details

Scale and detail drawings will be furnished where necessary by the Architects, and they shall be accurately followed in the execution of this work.

The Manufacturer shall prepare complete shop drawings and setting diagrams for all cast stone work, showing sizes, sections and dimensions of pieces, jointing, bonding, anchoring, and all other necessary details. Each piece of cast stone shall have a setting number.

Copies of all shop drawings shall be submitted to the Architects, one set to be approved by the Architects in writing thereon and returned to the Manufacturer before the manufacture of cast stone is started.

The General Contractor shall furnish to the Cast Stone Manufacturer all information necessary to enable the Cast Stone Manufacturer to properly check the cast stone with connecting structural work to insure that these shall be in perfect agreement.

Reglets, Rabbets, Slots, etc., as shown by the Architects' drawings shall be provided in cast stone to receive all flashing, sheet metal work, or other work which comes in conjunction with the cast stone.

Setting loops or Lewis holes shall be provided in the cast stone where necessary for hoisting purposes.

Kind and Finish

All cast stone used in this work shall be the product of a manufacturer having capacity and facilities for furnishing the quality, sizes and quantities of cast stone required without delaying the progress of the work and whose products have been previously used and exposed to the weather with satisfactory results.

All cast stone used in this work shall have a compressive strength of at least 5,000 lb. per sq. in. and an absorption of not more than 7 per cent nor less than 3 per cent when tested in accordance with the American Concrete Institute tentative specification for cast stone (P-3-A-29T).

All cast stone used in this work shall be (*Note*—Designate which one of the following classes and finishes is desired, and also indicate the approximate color and texture or grain desired in the cast stone):

Plain Cast Stone

Surfaced Cast Stone
- Hand rubbed finish.
- Brushed finish.
- Acid washed finish.

Cut Cast Stone
- Machine rubbed finish.
- Bush hammered finish.
- Machine tooled finish.
- Crandalled finish.
- Hand tooled finish.
- Sawed finish.

Each manufacturer bidding under this specification shall submit samples showing the quality and finish of the cast stone which he proposes to furnish. All cast stone used in this work shall conform in every particular to the sample as selected by the Architects.

Models and Carving

Clay or plaster models of all ornament shall be provided by the Manufacturer and shall be approved by the Architects either from photographs or by personal inspection before any work is executed therefrom.

Tests

The Architects shall have the privilege of selecting pieces of cast stone at random for testing. Tests shall be made by a laboratory approved by both the Architects and the Manufacturer and shall be paid for by the Manufacturer. The Testing Laboratory shall submit copies of test results to both the Architects and the Manufacturer.

Handling and Storing at Site

All cast stone when being removed from cars or trucks shall be handled throughout by competent workmen and by such methods as will guard against soiling, mutilation or chipping. The cast stone shall be stored at the building site, for whatever time, in such a manner that it rests entirely clear of the ground and be protected by proper means from damage to arrises and from contact with anything that would result in damage from accumulation of dirt, dust, grease or other staining or disfiguring elements. During extended periods of storage at the building site, the cast stone shall be covered with tarpaulins or stout non-staining paper. In no case shall the cast stone be stored under trees or other overhanging objects.

Setting Mortar

All cast stone shall be set in mortar composed of one volume portland cement, one volume cold lime putty and five volumes sand. Lime putty shall be made from the best quality lump lime slaked with cold water, screened through a $\frac{3}{16}$-in. mesh screen into a settling box, allowed to stand not less than one week and then mixed with sand and stacked to age. The correct amount of cement shall be thoroughly worked into the mixture in small batches just prior to its use for setting the cast stone.

Centering

All wood centering required for the proper setting of cast stone shall be furnished and erected by the General Contractor.

Anchors

All anchors used in setting this cast stone shall be wrought iron, zinc coated or dipped in asphaltum or red lead after fabrication. They shall be of sizes and shapes as indicated on the setting diagram and shall be furnished by the Erecting Contractor.

Setting

The Erecting Contractor shall set the cast stone in accordance with the requirements of the drawings. All exposed surfaces of cast stone shall be cleaned and the mortar surfaces of each piece shall be sponged with clean water just before setting. Each piece shall be set accurately, true to line, level and plumb by competent stone setters, with full flushed joints, all anchor holes being filled. The face of the cast stone shall be kept free from mortar at all times.

Pieces of cast stone in heavy projecting courses and other heavy projecting members shall be propped up until the anchoring has been built in and sufficient work is in place above to securely hold such members in position. Heavy blocks of cast stone shall not be set until the mortar in the joints below has thoroughly set. The use of pinch bars except on the backs of cast stone shall be prohibited. Each piece of cast stone, except where otherwise specified, shall rest on a full bed of mortar in sufficient amount to fill out to the edges of the piece on all sides. Each piece of cast stone shall be adjusted on its bed by striking with a wooden mallet or ram. Any piece which does not find its proper bed and accurate bearing shall be lifted and re-set on a new bed of mortar. All anchors and dowels as provided for shall be set in position as the courses are laid. All holes around anchors and dowels shall be entirely filled with setting mortar. Joints shall be raked out ¾ in. deep on the face for pointing.

Only the end of lug sills shall be set in a full bed of mortar, balance of joint to be left open until pointed.

Grouting and Caulking

All cornices, copings and projecting belt courses and pieces forming gutters shall be set with the vertical joints dry. These joints shall be caulked on the exterior profile with oakum and shall then be filled to within ¾ in. of the top with liquid grout composed of one volume portland cement and one volume of fine sand premixed at least one hour before being used and of as thick consistency as can be poured into the joints. After grout has thoroughly set the top joint shall be filled with lead wool caulked tightly against the edges and left slightly convex on top, or with an approved elastic caulking compound. Oakum shall be removed and the face joints pointed as hereinafter specified.

Protection

All cast stone work after setting shall be properly protected from damage by means of boards or other suitable covering, where necessary, until completion of the work. The Erecting Contractor shall co-operate with the Carpentry Contractor who will furnish and erect the necessary protection for this work. The Erecting Contractor shall be responsible for all breakage and shall replace all broken pieces at his own expense.

Cleaning

When ready for pointing, the face of all cast stone shall be scrubbed with a fiber brush, using soap powder and water, and shall then be thoroughly rinsed with clean water. Any mortar splashed or dropped on the face of cast stone during setting shall be immediately washed off with a sponge and clean water.

Pointing

All face joints shall be brushed out clean to a depth of ¾ in., the joint dampened and then carefully pointed. Pointing mortar shall be composed of one volume of portland cement, one-quarter volume cold lime putty and three volumes of clean, sharp and well-graded sand, premixed in small batches and allowed to stand at least one hour before being used. The pointing mortar shall be packed solidly into all joints, completely filling them. The form of the joint shall be as directed by the architects. Pointing shall not be done in freezing weather nor in locations exposed to hot sunshine unless properly protected.

Patching

The repairing of chipped or damaged cast stone shall be done only by mechanics skilled in this class of work, with materials furnished by this manufacturer and according to his directions.

Personnel of New Joint Committee on Concrete

W. A. Slater to Serve as Chairman—F. R. McMillan Elected Secretary and S. C. Hollister, Vice-Chairman—Report of 1924 to be Revised

Mention has been made in previous issues of CONCRETE of the work under way toward the appointment of a new Joint Committee on Specifications for Concrete and Reinforced Concrete, for the purpose of revising the 1924 report prepared by the previous committee.

Organization of the new Joint Committee was practically completed during the recent annual meeting of the American Society for Testing Materials, at which time the personnel was completed and permanent officers were elected.

W. A. Slater, director of the Fritz Engineering laboratory at Lehigh University, was elected chairman of the new committee. F. R. McMillan, director of research, Portland Cement Association, 33 W. Grand Avenue, Chicago, was elected secretary, and S. C. Hollister, consulting engineer, Swarthmore, Pa., is vice-chairman.

For more than twenty years the reports of the successive Joint Committees have served as standards for the design and construction of plain and reinforced concrete structures. The first committee issued progress reports in 1908 and 1912, following these with its so-called Final Report of 1916. The second committee completed its work with the report of 1924, after issuing a progress report in 1921.

The following comprise the membership of the new Joint Committee and the names of the constituent societies represented by each group:

American Concrete Institute

S. C. Hollister, chairman, consulting engineer, Swarthmore, Pa.
J. G. Ahlers, president, Barney-Ahlers Construction Co., 110 W. 40th St., New York.
F. H. Jackson, Bureau of Public Roads, Washington, D. C.
Ben Moreell, Lieut.-Commander, Puget Sound Navy Yard, Bremerton, Wash.
Norman M. Stineman, Editor, CONCRETE, 400 W. Madison St., Chicago, Ill.

American Railway Engineering Association

C. P. Richardson, Chairman, Masonry Committee, A.R.E.A.; Engineer, Track Elevation, C. R. I. & P. Ry., 431 S. Dearborn St., Chicago.
Meyer Hirschthal, Concrete Engineer, D. L. & W. R. R., Hoboken, N. J.
J. B. Hunley, Engineer, Bridges and Structures, C. C. C. & St. L. Ry., Cincinnati, Ohio.
J. F. Leonard, Engineer, Bridges and Buildings, Pennsylvania R. R., 729 Pennsylvania Station, Pittsburgh.
A. R. Ketterson, Asst. Engineer of Bridges, Canadian Pacific Ry., Montreal, Que., Canada.

American Society for Testing Materials

C. M. Chapman, Chairman, Consulting Engineer, 105 W. 40th St., New York.
P. H. Bates, Chief, Ceramics Section, Bureau of Standards, Washington, D. C.

A. T. Goldbeck, Director, Bureau of Engineering, National Crushed Stone Association, 1735 Fourteenth St., N. W., Washington, D. C.

E. E. Hughes, Vice-President, Franklin Steel Works, Franklin, Pa.

L. S. Moisseiff, Consulting Engineer, 68 William St., New York.

American Society of Civil Engineers

W. A. Slater, Chairman, Director, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

M. N. Clair, Vice-President, Thompson and Lichtner Co., Inc., Statler Bldg., Boston, Mass.

A. E. Lindau, President, American System of Reinforcing, 7 S. Dearborn St., Chicago.

F. E. Richart, Prof., Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill.

W. S. Thomson, Chief Engineer, Kalman Steel Co., Wrigley Bldg., Chicago.

Portland Cement Association

F. R. McMillan, Chairman, Director of Research, Portland Cement Association, 33 W. Grand Ave., Chicago.

D. A. Abrams, Director of Research, International Cement Corp., 342 Madison Ave., New York.

Ernest Ashton, Vice-President, Lehigh Portland Cement Co., Allentown, Pa.

J. H. Chubb, Manager, Service Department, Pennsylvania-Dixie Cement Corp., 521 Fifth Ave., New York.

H. G. Farmer, Manager, Service Bureau, Universal Atlas Cement Co., 208 S. LaSalle St., Chicago.

The new committee is expected to revise the 1924 report in the light of more recent advances in the knowledge about making and controlling the strength of concrete.

Reinforced Concrete Design Simplified

Balanced Tensile Reinforcing for Concrete Beams

Chart A (20,000; 3,000; 10)

By JAMES R. GRIFFITH

Professor of Structural Engineering, Oregon State Agricultural College

American Concrete Institute Building Code

$f_s = 20{,}000$ lbs. per sq. in.

$f'_c = 3{,}000$ lbs. per sq. in.

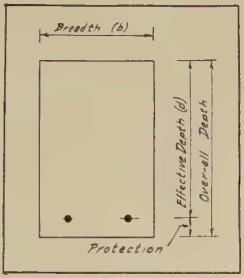
$n = 10$

$$f_c = 1200 \begin{cases} K = 197 \\ p = 0.0112 \end{cases}$$

$$f_c = 1350 \begin{cases} K = 235 \\ p = 0.0136 \end{cases}$$

$M = K\,b\,d^2$

$A_s = p\,b\,d$



BEGINNING with the March, 1928, issue of CONCRETE, a series of articles and charts were presented whose purpose was to simplify the routine problems of reinforced concrete design. The charts of the original series were built to conform to the Joint Committee Specifications using $f_s = 18{,}000$ lbs. per sq. in. and $f'_c = 2{,}000$ lbs. per sq. in. But we are in an age of progress. The American Concrete Institute Building Code has since been presented in which higher strength concrete and higher working stresses were permitted. Improvements in the field control of concrete mixes, and the use of central mixing plants, have tended to encourage the designer to use the material more economically. So beginning with the October, 1929, issue of CONCRETE the series was brought more up to date by a supplementary series of charts designed for the A. C. I. Building Code. It was decided to make these charts cover 2,000 and 2,500 lb. concrete for beams, and 3,000 lb. concrete for columns.

The original series, based on the Joint Committee Specifications, has since been reprinted with the charts on bond paper for use of the designer. The universal acceptance of this reprint has been encouraging. To meet a somewhat limited present and contemplated future demand, it seems best to add charts for beams of 3,000 lb. concrete and columns of 2,500 lb. concrete. Beginning with this issue the necessary additional charts will be presented.

On page 40 of the October, 1929, issue, a comparison was made showing the quantitative results to be obtained by the use of higher stresses. The solution isopleth on the chart of this issue carries the comparison to a still

(*Continued on page* 37)

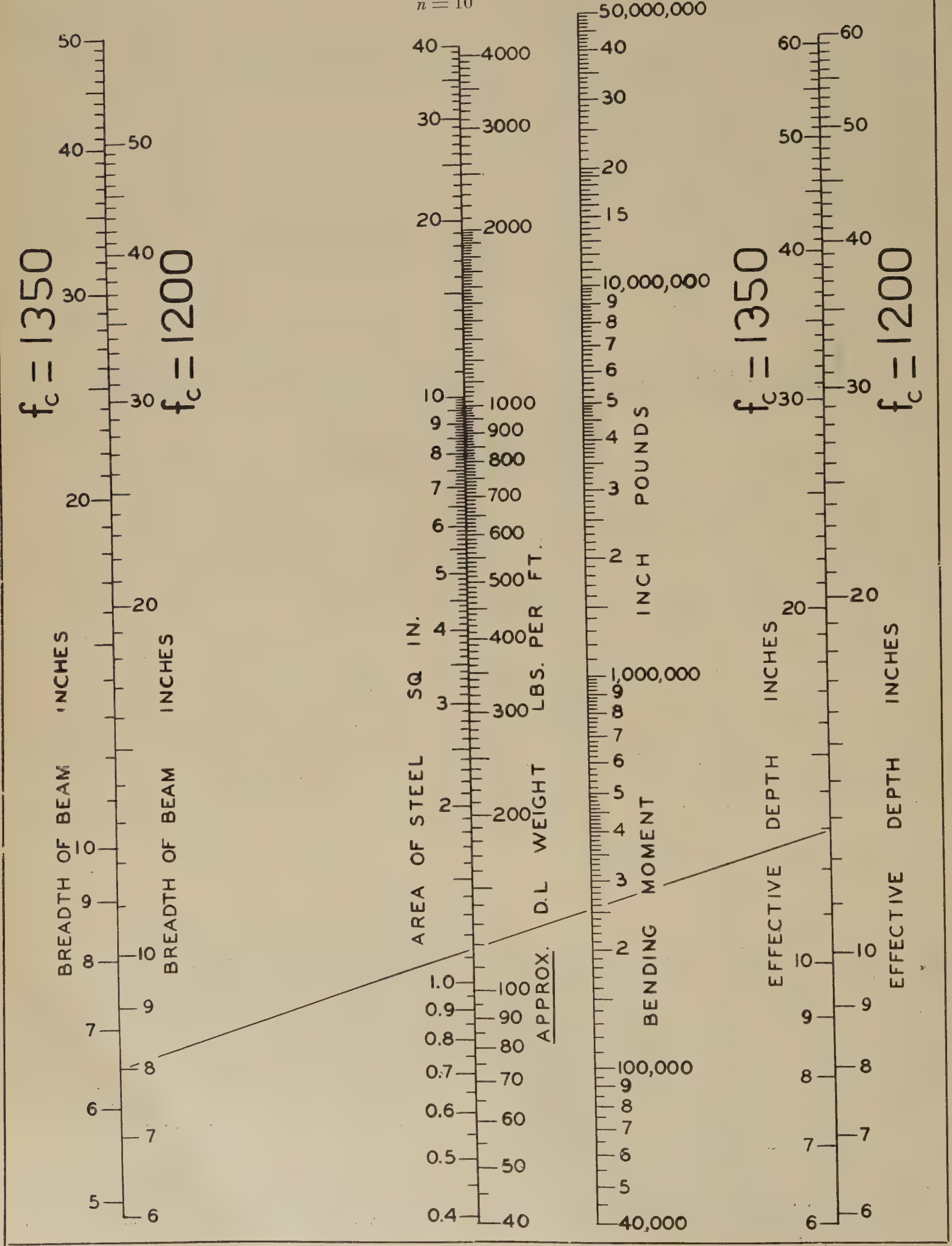
CHART A (20,000; 3,000; 10)

Balanced Tensile Reinforcing for Concrete Beams

$f_s = 20,000$

$f'_c = 3,000$

$n = 10$



higher strength concrete. Using the same bending moment of 256,000 in. lbs. and the constant breadth of 8 inches, I have obtained the following results:

$f_s = 20{,}000$ lbs. per sq. in.
$f_c = 1{,}200$ lbs. per sq. in.
$n = 10$
$b = 8$ in.
$d = 12.7$ in.
$A_s = 1.14$ sq. in.
Concrete percentage = 83.6
Steel percentage = 106.5

The percentages, as in the original comparison, are based on the original series as 100 per cent.

Since the construction of all preceding charts has been explained in detail, the explanation will not be duplicated in these additional articles. In this chart, the same scale spacing has been used; the same relative scales have been used; while the scales have been shifted vertically to conform to the change in stress.

A. S. T. M. Appoints New Committee Officers

The American Society for Testing Materials has appointed several new officers in Committee C-2 on Reinforced Concrete and in Committee D-4 on Road and Paving Materials. In Committee C-2 S. C. Hollister, consulting engineer, Swarthmore, Pa., has been elected chairman, and Prof. W. A. Slater, director of Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa., is secretary. In Committee D-4 the new chairman is P. J. Freeman, chief engineer, Bureau of Tests and Specifications, Department of Public Works of Allegheny County, Pittsburgh, Pa.; and three new vice-chairmen are H. L. Howe, director of design and construction, Department of Public Works, Rochester, N. Y.; A. T. Goldbeck, director of the Bureau of Engineering of the National Crushed Stone Association, Washington, D. C., and C. S. Reeve, chief chemist of the development department of the Barrett Company, Leonia, N. J.

How to Save in Concrete Form Work

Form Work for Typical Tower, Free on Three Sides—Assembling, Bracing and Supporting

IX—Forms for Towers

By A. B. MacMILLAN
Chief Engineer, Aberthaw Company, Boston, Mass.

IT frequently happens that one or more towers form a part of the architectural scheme of a building. These towers are perhaps most familiar in modern office and hotel buildings; but that is by no means the only type of building in which the the contractor encounters them. They occur also in smaller and less pretentious buildings, such as hospitals, school buildings, storage warehouses, and in many of the more substantial industrial plants.

Form Work for a Typical Tower

It would be futile to try to cover all the general types of design and construction involved in these towers. They occur in all sizes and shapes. In some instances the tower forms an integral part of the building up as far as the roof of the main structure, while in others it is free from the building for the greater part of two or three sides of the tower.

Under the circumstances it is best to take a more or less typical case, a type of tower that occurs quite frequently, and show details of the form work required. These details then suggest the details and methods to be followed in other cases.

The tower to which these form details apply is free on the greater part of three sides. In the plan in Figure 46 we may consider that the side along the bottom is in contact with the main building, the two columns at the lower corners of the drawing being approximately an extension of the line of exterior wall columns in the building. This tower has solid walls at the right and left sides (Figure 46), while the upper side consists in large part of window openings, the window construction being supported on wall girders that span from one corner column to the other. One of these wall girders is shown in the lower part of Figure 48, and the form work for the corresponding girder in the next story above may be seen in the upper part of the same drawing.

Thorough Bracing is Important

In assembling the form work for such a tower, we erect the forms for one story at a time, and we brace them thoroughly with diagonal braces of 1 by 6-inch material, as indicated in Figures 47 and 48. Other bracing is placed horizontally, made of 3 by 6-inch material. This horizontal bracing is shown in plan in Figure 46, in cross-section in Figure 47, and in elevation in Figure 48. It assists in maintaining the vertical alignment of the form work. In addition, horizontal diagonal wires are twisted across the tower form work just above and below the horizontal 3 by 6-inch bracing. All this bracing is necessary, and under no circumstances should any of it be omitted. Without ample bracing the form work may be racked out of plumb, under the vibration resulting from the delivery of concrete and dropping of it into place.

Supporting the Form Work

The form work for a story of the tower is supported at the corners (the columns) by "Ell" blocks, which are provided in advance in the manner described in the March installment of this series. The "Ell" blocks and their use are illustrated in Figures 15 and 16, which should be studied in connection with Figures 47 and 48.

The Form Assembly

So far as the assembly of the form work is concerned, the details are very much as given previously, in Figures 37 to 40 inclusive, in the July installment of these articles, dealing with the assembly of wall forms. Double waling strips similar to those detailed in Figure 38 serve as the main holding members. As with the regular wall forms, ⅝ or ¾-inch tie bolts and washers, passed either through tin sleeves or through concrete spreaders, hold the waling strips against the vertical studding. If tin sleeves are used, wooden spreaders are commonly employed, while the concrete spreaders serve also as sleeves (See Figure 38).

Observe in the plan in Figure 46 how it is possible to extend the waling strips along the full length of the tower on the outer sides (extreme right and left sides of Figure 46) when there is only a small offset (or none at all) between the face of the column and the face of the wall. In this case the amount of the offset is made up by placing the vertical studs the flat way against the column forms at the corners of the tower.

In most respects this form work is so similar to the work detailed and described in previous articles that there is no need for further description. The previous drawings to which reference is made in this installment should be studied in conjunction with the details given here.

Reinforced Concrete Stairway Forms

The next article will deal with form work for reinforced concrete stairways. The author realizes that concrete stairway form work is dreaded by construction superintendents and foremen who have had limited experience in complicated form assembly and erection. It is hoped that the details may be made sufficiently clear to remove the dread from the minds of readers.

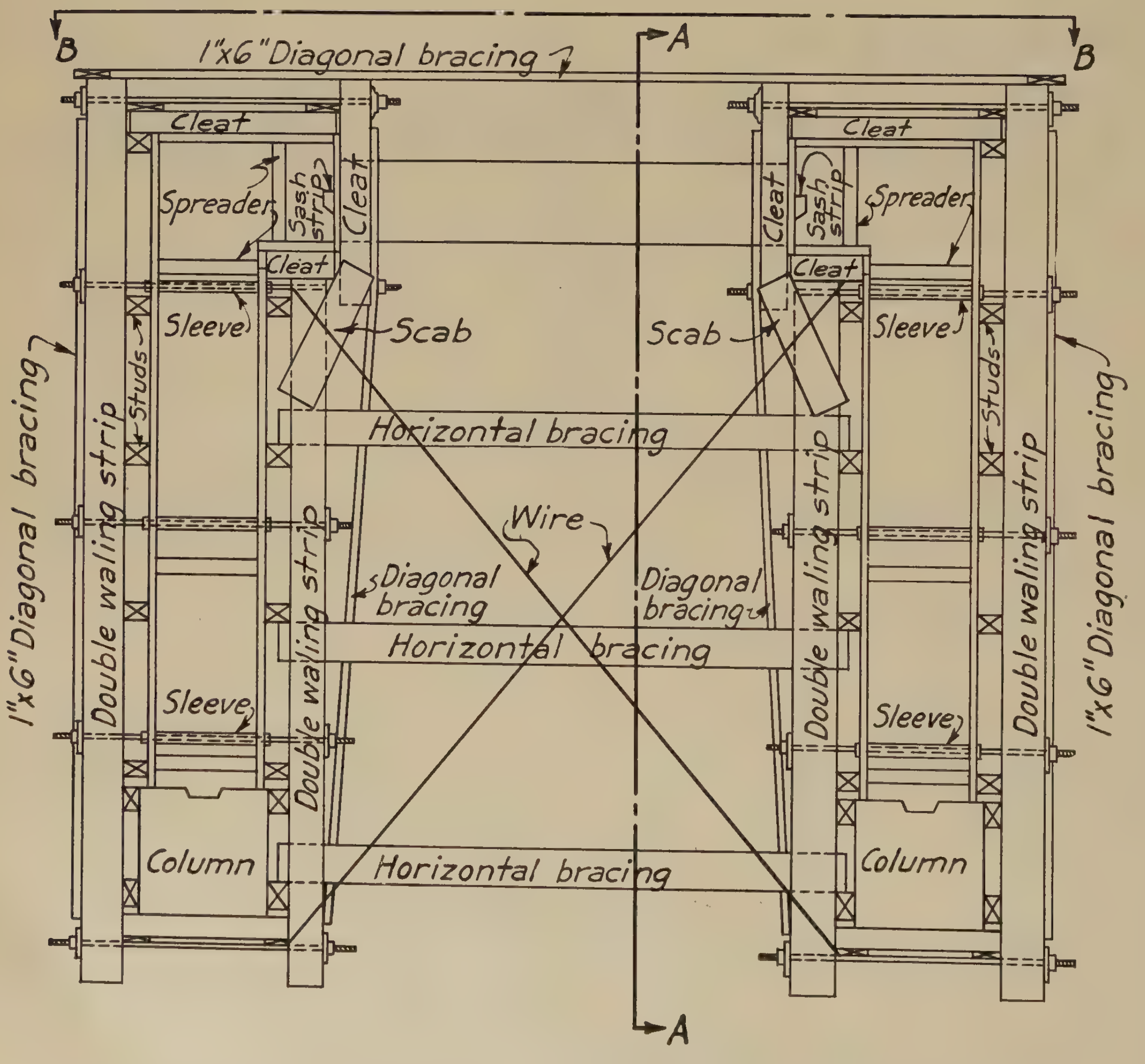


FIGURE 46 - ASSEMBLY PLAN OF FORMS FOR TOWER

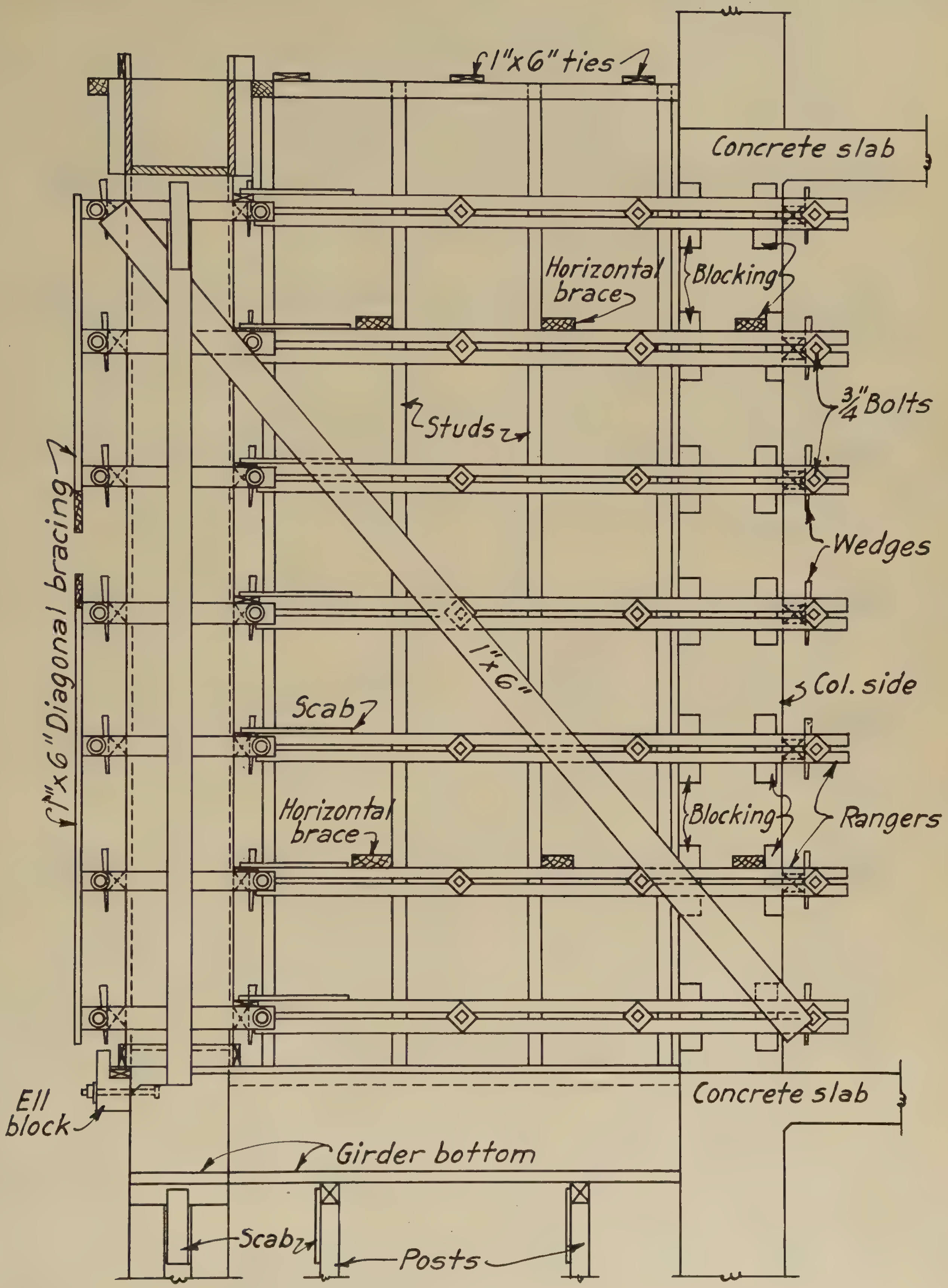


FIGURE 47 - SECTION A-A (IN FIGURE 46)

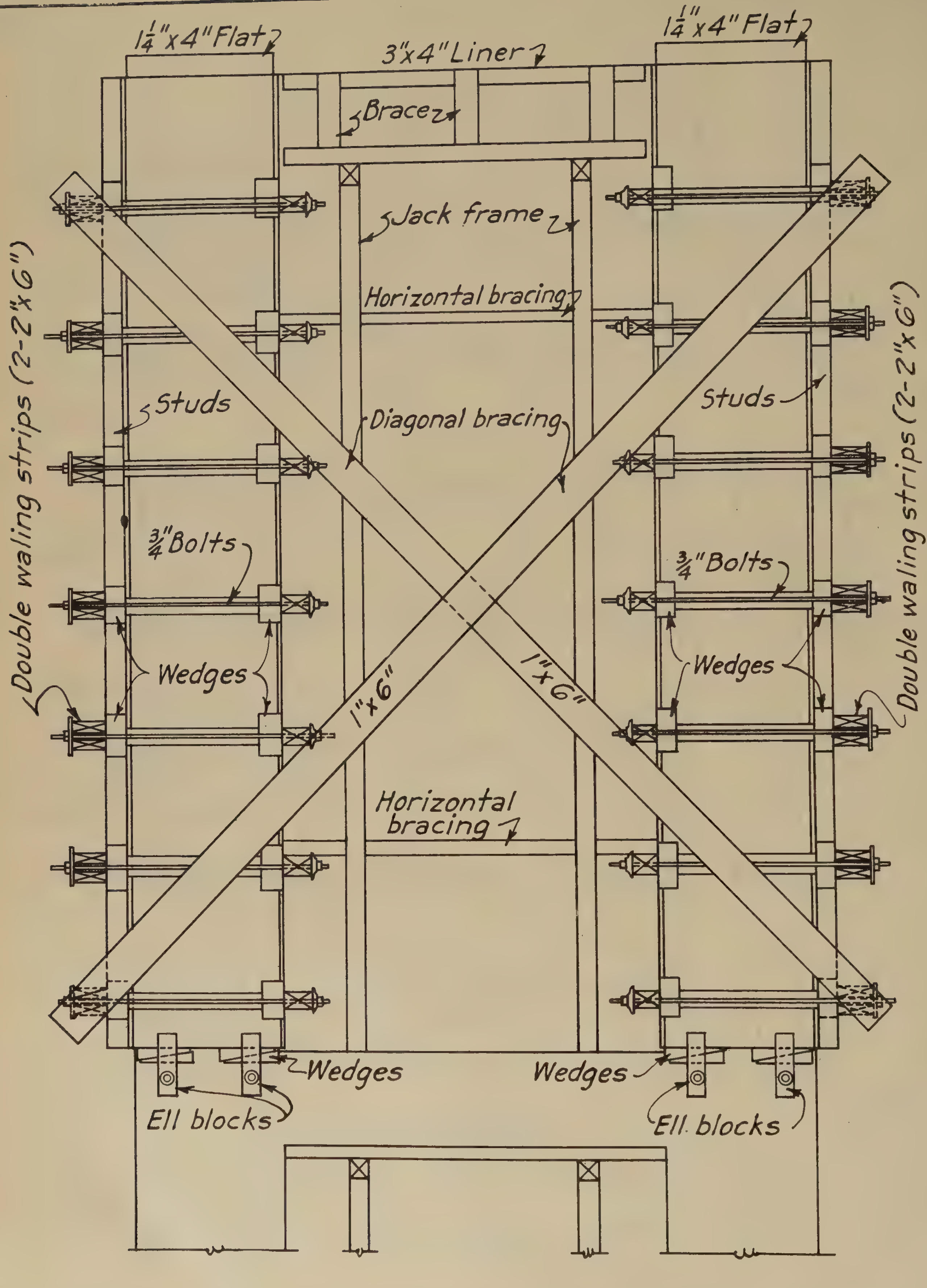


FIGURE 48 - ELEVATION AT B-B (IN FIGURE 46)

Bond and Compressive Values of High Early Strength Concrete

Briton Makes Comparisons with Concrete from Ordinary Portland Cement—Higher Working Stresses and Earlier Stripping of Forms Justified—Compression Test Results More Consistent Than Bonding Values

By SIR E. OWEN WILLIAMS, K.B.E.

With the advent of high early strength portland cement and the adoption of tentative specifications for such cement by the American Society for Testing Materials, designers and builders of reinforced concrete structures will be confronted with new problems. This article, which is reprinted from the March issue of "Concrete and Constructional Engineering," indicates that British designers are encountering similar problems. What working stresses, for instance, may be employed? Shall working stresses be based on the estimated 28-day strength or the 7-day strength? Does the bonding strength increase as rapidly as the compressive strength? May form work be stripped sooner?

These questions have not as yet been answered; but the results of the tests here described point out the directions in which further investigation is required.

ABOUT a year ago I was asked by the Cement Marketing Company if I would express an opinion on the properties of rapid-hardening portland cements and their value to the designer and constructor. I replied that such experimental work as I had carried out with rapid-hardening portland cements was so limited in scope that I was unable to commit myself to an exact statement of their value. I also suggested that whilst I had seen many tests on the compressive and tensile values of rapid-hardening cements at early dates, yet I had seen no similar tests relating to their adhesion to steel. It is clear that a material which has high compressive values at any early date would have little advantage over ordinary cement unless the adhesion of the reinforcing bars was also similarly improved. The Cement Marketing Company then offered to bear the expense of any tests I made to satisfy myself on the two major figures of the compressive and adhesive strengths at early dates. I agreed to this, with a proviso that whatever the results were they would be published in toto.

Two Mixes Used

I instructed Messrs. Riley, Harbord & Law to carry out the tests to my specification, including the selection of materials, manufacture of the test-pieces, and the subsequent testing. Two mixes of concrete were employed, viz. 1:1:2 and 1:2:4. The age of the specimens at testing dates was to be 2, 7, 28 and 90 days, with further long-period tests which have not yet been completed. Compressive tests were on 6-in. cubes. Adhesion tests were carried out with polished steel bars.

The adhesion test-pieces consisted of blocks of concrete 12 in. or more long by 6 in. square, and from each end bars projected having the appearance of continuous bars running through the center of the test-pieces. Actually the bars were in two lengths with butt joints at the centers of the blocks, and could be pulled as in a usual tensile test. The blocks of concrete were prevented from cracking in the center by separate reinforcement in their corners.

Four Cements Tested

Four kinds of cement were tested, designated as follows:

O.—An ordinary portland cement which was selected as just passing the British Standard Specification.

P.—A high-quality portland cement but not claiming rapid-hardening qualities.

O.F.—A normal rapid-hardening portland cement.

P.F.—A still higher quality rapid-hardening portland cement.

The cement marked "O" was used to provide a basis of comparison. All concretes used in the test-pieces were carefully gauged with water to provide the same degree of workability. In the following tabulated results the actual compressive values are not given but are reduced to a percentage of a 28-day test of a 1:2:4 concrete made with mark "O" cement. This is adopted to simplify comparison. The results are as follows:

1:2:4 MIX

	Cement O.	Cement P.	Cement O.F.	Cement P.F.
Age of test	Per Cent	Per Cent	Per Cent	Per Cent
2 days	Not tested	Not tested	100	185
7 days	70	170	220	310
28 days	100	225	295	395
90 days	155	315	400	450

1:1:2 MIX.

1:2:4 *at* 28 *days mark "O." cement* = 100 *per cent*

	Cement O.	Cement P.	Cement O.F.	Cement P.F.
Age of test	Per Cent	Per Cent	Per Cent	Per Cent
2 days	—	—	140	255
7 days	120	250	320	425
28 days	175	370	390	530
90 days	255	480	515	560

The practice hitherto with an ordinary cement has been to strike the centering in 21 days, at which time, on the results of these tests, it can be deduced that the compressive value of a 1:2:4 mix would be 90 per cent of its

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Reprinted from March, 1930, Issue of *Concrete and Constructional Engineering.*

28-day value. This value is reached in less than two days with cement "O.F." and probably in one day with "P.F.," at which time centering could be struck if the design were based on the same stresses. At 7 days the strength of concretes with "O.F." and "P.F." cements would be about 2½ to 3½ times as great as a 21-day 1:2:4 concrete with mark "O." cement. At 90 days concretes made with "O.F." and "P.F." cements are from two to three times as strong as the corresponding 1:2:4 mix made with mark "O." cement. It is a reasonable deduction that with rapid-hardening cements designers could work to double the stresses in the concrete and strike centering in 7 days instead of 21.

For the richer mix, namely, the 1:1:2, the same deductions, slightly modified, hold good. With a rich mix the improvement in the concrete with improvement of cement was not quite so pronounced, due to the fact that the strengths of the concretes were so high that quality of aggregate began to control the compressive values. However, at seven days with this mix the concrete with cements "O.F." and "P.F." are 2 and 2¾ times, respectively, as strong as concrete with mark "O." cement at 21 days. At 90 days they are still both more than twice as good, so that the same general deduction holds, viz., that their use enables designers to double the stresses and strike centering within 7 instead of 21 days.

Results Erratic

The results of the bond stress experiments were somewhat erratic. Polished bars were used with the idea of reducing the variations which were anticipated, but they probably had the reverse effect. However, it was clear that the bond with rapid-hardening portland cement at 7 days was certainly greater than the bond with concrete 21 days old made with mark "O." cement, and indeed in certain cases it was twice as good. The results, however, were not sufficient to justify an increase in bond by the use of rapid-hardening cements, but indicate that the growth of bond is sufficiently rapid to permit earlier stripping.

The cement mark "O." was equal to the cement required by the London County Council Regulations, under which concrete made with this quality cement is allowed a working stress of 600 lbs. per sq. in. for a 1:2:4 mix and 750 lbs. per sq. in. for a 1:1:2 mix.

It is evident that a considerable increase on allowable stresses is permissible if high-quality cements are used, and that with rapid-hardening cement it would be safe to allow striking of centering to beams at 7 instead of 21 days.

It is interesting to observe that if the improved quality of present-day cement is used by the designer the total cost of cement in a given structure would be less than in any similar pre-war structure in spite of the difference in cost per ton. The quality of cement has increased far beyond the increase in unit cost, but if designers continue to work with pre-war stresses and post-war prices they get the worst of both worlds!

Building Test Highways at Arlington, Virginia

Test sections of concrete highway pavement slabs are being built under the direction of the United States Bureau of Public Roads on the experimental farm of the Department of Agriculture at Arlington, Va.

These slabs are being built in full sizes and of various designs and cross sections. The slabs are to be tested during the week beginning October 6th, and the tests are expected to be witnessed by many of the delegates to the International Road Congress meeting in Washington during that week.

Some of the test slabs, which are 20 ft. wide and 40 ft. long, are of uniform thickness. Others will be thickened at the edges. In still others the surface of the concrete slab is raised at the edges so as to form a low rounding curb. Still other designs have the curb combined with a thickening of the edge of the slab at the bottom.

Experiments will also be made on the bonding strength of bars used as dowels between joints. Considerable attention will, in fact, be given to various phases of pavement joint construction.

Mellon Institute to Increase Research Facilities

The Mellon Institute of Industrial Research contemplates an extensive enlargement of its research facilities by the construction of a 7-story building of classic architecture, about 300 or 400 ft. in plan, thereby providing needed laboratory space to carry on the work of additional industrial fellowships.

At the present time 63 such fellowships are represented in the activities of the Institute, but for nearly ten years the Institute has had a waiting list of industrial concerns, at times almost as long as the roster of companies whose problems were being investigated. After the new building is completed, many additional fellowships can be accommodated.

Janssen & Cocken, of Pittsburgh, are the architects for the new building.

Reinforcing Meeting

The Concrete Reinforcing Steel Institue, Chicago, has announced October 20th to 22nd as the time of its semi-annual meeting, to be held at Briarcliff Lodge, Westchester County, New York.

Personals

J. C. Baxter has resigned as vice-president and contract manager of A. Guthrie & Co., effective June 30th, to become a member of the reorganized contracting and engineering firm of Carey, Baxter & Kennedy, 307 West 49th Street, New York, formerly known as Kennedy & Carey.

Mr. Baxter's last important work with the Guthrie organization was the recently completed 8-mile Cascade tunnel on the Great Northern Railway. Kennedy & Carey have just completed 150 kilometers of the Cochabamba-Santa Cruz Railway for the Bolivian government.

Charles E. Grubb has been appointed engineer-executive of the County Highway Officials' Division of the American Road Builders Association.

Mr. Grubb will devote his efforts to the activities and development of the division and will be located at the Washington, D. C., headquarters. He is a past president of the county organization and was formerly county engineer for New Castle County, Delaware.

James Lyman, consulting engineer, 20 North Wacker Drive, Chicago, and his son, *Oliver Lyman,* sailed early in August for a tour through England, France, Belgium, Holland and Germany.

L. E. Myers, head of the L. E. Myers Company, general contractors, of Chicago, was elected president of the Board of Education of the City of Chicago on July 23rd.

Don't Wait to See What Happens

Winter Concreting No Longer a Problem—Should Not Allow Cold Weather to Retard Construction Revival—Every Job Will Contribute to Improvement—Taking a Tip from Canada—How One Contractor Built a Bridge

THE winter season must not be allowed to check a construction revival; and it will not if everyone in a position of influence keeps on his toes.

All indications point to a gradual improvement in the general level of business activity this fall, an improvement which should be felt in most of the branches of industry. It would be most unfortunate if even a single concrete construction project that might be started this fall and continued throughout the winter should be "put off until spring." Every construction job that is postponed is a blow to business revival. It pushes the day of definite improvement in all industries that much farther into the future.

During a business depression the tendency to "wait and see what happens" is often too strong to be overcome. That is what prolongs business depressions. Back of this waiting tendency is the old story of finding it easier to do nothing than to come to a definite decision that requires action.

Under the circumstances attending the present business conditions there are several special and forceful reasons why general construction work should proceed unchecked during the coming winter.

First of all is the reason already touched upon—namely, that a seasonal drop in construction volume will spoil the present upturn in building.

In the second place, there is the reason that concrete road and pavement work is forced to stop on account of cold weather. That is the one form of concrete construction, and about the only one, that must be discontinued during cold weather, for the long-drawn-out nature of the work would make the cost of protective enclosures prohibitive. This year, as is well known, state highway officials and other public officials made special efforts to push road and paving work. As a result, the contracts awarded for concrete roads and pavements thus far this year are about ten per cent higher than in the corresponding part of last year. In consequence, when this work stops the effect will be more keenly felt than in previous years. Because of this circumstance, other construction work will be needed in greater volume than in previous winters to offset even partially the cessation of paving work.

Here is where courage and determination will be needed on the part of architects, engineers and contractors. Architects and engineers must have facts and figures and the necessary persuasive powers to convince their clients that all concrete construction work can be built in winter as readily and as safely as in any other season, and that the financial advantage lies with the owner who will not wait to build until everyone else is ready to do the same.

Contractors must prove that they know how to build concrete work in winter at only a nominal increase in cost, an increase so small that usually it is offset by the financial advantage of the earlier completion of a project. With our present knowledge of winter concreting methods there is no excuse for postponing any concrete work, aside from road and street pavements, on account of approaching cold weather.

Many large construction companies have for some years completely ignored winter weather and have continued concrete building operations without interruption, keeping their crews and equipment at work. Smaller concerns who are still inclined to be frightened by the bugaboo of cold weather might well take a leaf from the practice of the Canadian construction industry. In Canada the winter season is so prolonged that no one thinks of stopping concrete construction because of cold weather. Winter concreting methods are not even a problem with Canadians. They go ahead without a thought of doing otherwise, and when cold weather comes all new concrete work is protected by methods well known to all builders.

Some eight or nine years ago a contract was awarded in late autumn for a 3-span reinforced concrete arch bridge over the Little Goose River near Sheridan, Wyoming, that was to form an important connecting link in the state highway system. The highway department desired to have the structure built during the winter so that the highway might be available in the early spring season. Much less was then known about winter concreting methods than is known today; but the contractor had both imagination and horse sense. He obtained an old circus tent, set it up over the site, and built the bridge in the dead of winter. The tent was heated and the men worked in comfort. The water flow problem was eliminated, for all the water in the river and its tributaries was frozen solid!

This coming winter, of all times, is the time to go ahead with new construction work, for every job, however small, will contribute its bit toward a more rapid revival of all construction work.

INFORMATION *and* CONSULTATION

THE HOW-TO-DO-IT DEPARTMENT

These columns are devoted to helping readers solve their problems in all phases of concrete work. Inquiries are invited. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Formula for Measuring Moisture in Aggregates

I am greatly interested in the article by D. D. McGuire and W. H. Rowan, on page 41 of the May issue of CONCRETE, *entitled "New Pycnometer Measures Free Moisture in Aggregates." Can you supply me with the derivation of the moisture formula?—S. J. C., Rio de Janeiro, Brazil.*

The formula to which reference is made is written

$$\frac{G_s - G_w}{G_s \times (G_w - 1)} \times 100 = M$$

In this formula *M* is the percentage of free moisture. Mr. McGuire has kindly supplied the following derivation:

W_1 = Weight of pycnometer full of water.
W_2 = Weight of sample, saturated and surface-dried.
W_3 = Weight of sample containing free moisture.
W_4 = Weight of pycnometer and sample W_2 with enough water to reach point of bar.
W_5 = Weight of pycnometer and sample W_3 with enough water to reach point of bar.
G_s = Apparent specific gravity, in a saturated and surface-dried condition.
G_w = Apparent specific gravity, in a wet or stock-pile condition.
M = Percentage of free moisture.

It may be seen that G_s is the ratio of the weight of the saturated and surface-dried sample to the weight of water displaced by that sample. The value of G_s may be written

$$G_s = \frac{W_2}{W_1 + W_2 - W_4}$$

Likewise, G_w is the ratio of the weight of the sample containing free moisture to the weight of the water displaced by that sample. Its value may be written

$$G_w = \frac{W_3}{W_1 + W_3 - W_5}$$

The quantity of water displaced by the sample containing free moisture is greater than the quantity of water displaced by the sample when saturated and surface-dried. This excess water is caused by the free moisture and is, of course, equal to the free moisture. The percentage of free moisture, designated as *M*, then is obtained from the first of the three formulas given above.

Reinforced Concrete First Floor

I am going to build a residence and would like to use cincrete as the aggregate for the concrete in the first floor. The longest span will be 13 ft. What mixture should be used, and what should be the size and spacing of reinforcing bars?—E. J. P., Racine, Wis.

This is a matter that involves a structural design to fit each case. We suggest you engage a local structural designer to prepare a design for you in accordance with the requirements of the Racine building code. Or, if you prefer, you might ask the Cincrete Corporation, 591 Canal St., Milwaukee, Wis., for assistance.

Tamping Concrete for Garden Furniture

I have had trouble in tamping concrete for garden furniture. My trouble is in getting enough water into the mixture to make the concrete strong and still make it possible to tamp it. Can you advise me of any preparation or powder that could be used along with more water, so that the mixture could be tamped?—C. J. B., Worcester, Mass.

It would seem that the trouble mentioned in your letter might be eliminated by adding more cement when you add more water. You are probably using a one-to-three mix, which is about right, but are you not overlooking the fact that you are thinning your mix when you add more water without adding cement?

On pages seven and nine of every issue of CONCRETE there is a list of various materials to use in the making of concrete and the manufacturers who make them. But, instead of trying these now, we would suggest that you experiment with equalizing your cement and water to the proper water-cement ratio, and see if this does not clear your troubles.

A Leaky Basement Wall

Please advise me on the best method for waterproofing a basement wall. The house has been built for some time. The walls are of brick and are in good condition, but during the last four years there was much leakage during wet weather. I am anxious to do a good job, for we have other basement walls in our town which need similar attention.—L. E. G., St. Elmo, Ill.

You can probably correct this condition best and with the least trouble in the end by getting at the wall from the outside. This method makes it necessary to dig a trench about a foot wide all around the house, to permit the application of a waterproofing coat of portland cement plaster, or some proprietary waterproofing compound, on the outside face of the wall.

Once the trench is dug, however, you will be able to place a line of drain tile along the wall footings and connect this drain up with a storm sewer or some natural drainage system. The cause of the trouble will then be removed.

It is well also to examine the downspouts of the house, to see whether the drains from the spouts are clogged up or in working order.

Concrete for the Builder

A Department Devoted to the Promotion and
Practical Construction Details of Concrete Work

How to Produce Colored Concrete Work

Series of Two Articles by W. D. M. Allan Describes Selection and Use of Oxide Colors—May Obtain Any Shade Desired—Some Simple Tests of Quality

I—Color Pigments For Use With Concrete

By W. D. M. ALLAN
Manager, Cement Products Bureau, Portland Cement Association

Because there is a demand for color in all things, builders throughout the country are interested in the art of producing colored concrete of high quality. This article, the first of two on this subject, deals with color pigments, for the selection of suitable mineral colors is the first important step in producing good work.

Mixing, placing and finishing colored concrete will be discussed in the second article.
—The Editors.

IN general, there are three methods of coloring concrete. First, there is the integral mixture of color pigments; second, the use of colored aggregates exposed by surface treatment; and third, surface treatment by means of paints or other cover coats. The use of mineral pigments is receiving considerable attention at this time.

While color pigments have been used in coloring concrete for several years, there has never been a definite recommended practice established as to the type, quality, amount and use of pigments. Recently, however, the Portland Cement Association concluded a series of tests on color pigments suitable for use with cement, resulting in the establishment of certain fundamental principles which will be found helpful in producing a satisfactory colored concrete job. The recommendations are general, however, and it must be thoroughly understood that no definite law can be stated which will hold true for all pigments. It is recommended, therefore, that manufacturers' directions also be followed in every case.

Color Requirements

A color pigment suitable for use in concrete must fulfill the following requirements.

1. It must be durable under exposure to sunlight and weather.
2. It must produce intense color when finely pulverized.
3. It must be of such a composition that it does not react chemically with the cement to the detriment of either cement or color.

It has been found that these requirements are best fulfilled with mineral oxide pigments. Other types of pigments such as organic dyes have a tendency to fade and

This attractive driveway is built with a center strip of green colored concrete. Curbing and border are natural color

many of them reduce the strength of the concrete. The following table indicates permanent colors which may be obtained in concrete, and the kind of pigment required to produce them.

Buff, yellow, red	iron oxide pigments
Green	chrome oxide
Blue	ultramarine blue
Brown	iron oxide or iron and manganese oxide pigments
Black	iron oxide, manganese dioxide, carbon black, bone ash and the so-called mineral blacks.

The color which is produced in concrete is determined principally by the ratio of pigment to cement, not by the ratio of pigment to cubic feet of mortar or concrete. For this reason, modern color specifications give the weight of color pigment to be used per sack of cement.

Concrete colored red is used in the center or field of this walk and driveway, the border being natural gray concrete

It has been found that pigments may be safely used in amounts up to but not exceeding 10 per cent of the weight of the cement—that is, about 9 pounds of color pigment per sack (94 pounds) of cement. These limits may be exceeded with some pigments, and under certain conditions, but in these cases the manufacturers' directions should be followed.

The quantity of pigment necessary to produce a certain color depends upon the kind of pigment being used. There can be no definite amount of pigment specified for a particular color, because each brand of pigment differs somewhat; that is, two pigments of the same type but from different sources will usually produce different hues or shades.

How Variations Are Obtained

With high-grade pigments the amount previously recommended as a maximum—10 per cent of the weight of the cement—usually will produce the deepest shade of any one color. Lighter shades of a certain color may be obtained by using less pigment, and variations of colors or shades are obtained by mixing two or more pigments. It is recommended that white portland cement be used when delicate tints of light colors are desired.

Variations in the composition of concrete materials as well as in the color pigments make each color formula only an approximation. For this reason, it is suggested that, after selecting the primary color to be used, the exact shade required may be produced by preparing a number of small mortar panels with the same materials as are intended for the finished job. The various proportions used in the different panels should be carefully recorded so that when the correct shade is determined, the proportion for that shade can be accurately followed on the job. The mortar samples are stored away for four or five days under conditions similar to actual exposure and then inspected.

Determining the Quality of Pigments

Mineral pigments vary considerably in their tinting values. Chemically pure colors are the only ones with which reliable, permanent, bright, beautiful hues can be obtained satisfactorily. In this connection, a report of Committee 703 of the American Concrete Institute states: "A quantitative rating of tinting qualities would probably show an advantage for the better quality pigments, even though the price per pound is higher."

Most architects and builders depend upon the reputation of the manufacturer of pigments for assurance that the quality of the material is satisfactory. There are, however, a few simple tests that can easily be made which will often be of assistance in determining the suitability of pigments, although a complete examination would require extensive physical and chemical tests. These simple tests follow:

1. The finer a pigment is ground the greater is its coloring ability. Likewise, smaller amounts of fine pigments are required for certain shades. To insure thorough mixing, the pigment should be at least as fine as the cement. Standard specifications for cement require that 78 per cent pass a sieve having 40,000 meshes to the square inch.
2. The ability to resist the action of lime, the principal alkaline ingredient of cement, can be tested by mixing a sample pat of 20 parts of cement and one part of the pigment and observing for several days, meanwhile keeping the specimen moist. Any pronounced fading indicates that the pigment is not lime-proof.
3. To test the durability of the color under the influence of light takes some time unless a special artificial light is at hand. Pronounced fading of a colored mortar on exposure to sunlight for one month is evidence that the pigment is unsuitable.

The principal points to be remembered in selecting and using color pigment with concrete may be summarized as follows:

1. Only high-grade, chemically pure mineral oxide pigments should be used.
2. The ultimate color of concrete is determined by the ratio of pigment to cement, not by the ratio of pigment to mortar or concrete.

3. The quantity of pigment used should not exceed 10 per cent, by weight, of the cement.
4. There is no definite color formula for producing any one particular color; sample panels should be made to determine the desired shade and the proportions necessary to produce that shade.
5. Quality, not price, should be the basis for selecting a color pigment.
6. In all cases, manufacturers' directions for the use of the pigment should be followed.

This serviceable driveway is built with a center strip of red concrete; outside strips are of gray concrete. It blends well with the landscaping and the red brick of the house

Regardless of how much care is taken in the selection of high-quality color pigments suitable for use with cement, the subsequent operations in producing colored concrete, such as mixing, placing, finishing and curing, must be carefully and thoroughly done if a satisfactory job is to result. In a following article these important operations will be discussed and some helpful suggestions given.

Meetings for Concrete Contractors Scheduled for Month of September

Another series of meetings for concrete contractors has been scheduled by the Portland Cement Association for the month of September. Contractors in Missouri, Pennsylvania, Ohio and New Jersey have the opportunity to attend these conferences which will deal with the present markets for concrete work which have been uncovered as a result of a recent survey of local markets made by the Portland Cement Association.

Each of these meetings is intended to show local contractors existing markets in various fields—around homes, parks, schools, playgrounds, industrial plants and on the farm. There is an exceptionally good market on farms at this time due to the recent drought, making it necessary for farmers to provide additional storage facilities for feed crops which can be used during the coming winter.

In the amusement field, there is a new market for concrete around miniature golf courses which are becoming popular. How concrete contractors can get some of this work will be discussed at the meetings.

Time payment plans also will be discussed. Many contractors are interested in selling concrete improvements on time payment plans in order to stimulate construction in the residential field.

The list of meetings scheduled for September follows:

Date	*City*	*Meeting Place*
Sept. 3	Kansas City, Mo.	Assembly Room, Builders Assn. of Kansas City, 20 W. 9th St.
Sept. 4	Pittsburgh, Pa.	Builders Exchange, Third Floor, Fulton Bldg., 107 6th St.
Sept. 9	St. Louis, Mo.	Fifth Floor, Pythian Bldg., N. Grand Blvd. & Delmar Ave.
Sept. 9	Harrisburg, Pa.	Room 212, Harrisburger Hotel.
Sept. 10	Columbus, O.	Assembly Room, Builders Exchange, 240 N. High St.
Sept. 11	Lancaster, Pa.	Lancaster Chamber of Commerce, Second Floor, Orange & N. Queen Sts.
Sept. 12	Cincinnati, O.	Assembly Room, Allied Construction Industries, 622 Broadway.
Sept. 15	Reading, Pa.	*
Sept. 16	Dayton, O.	Assembly Room, Dayton Industries Bldg., 3rd & Ludlow Sts.
Sept. 18	Allentown, Pa.	*
Sept. 19	Toledo, O.	Room 1029, Waldorf Hotel.
Sept. 24	Philadelphia, Pa.	*
Sept. 25	Cleveland, O.	Parlor C, Hollenden Hotel.
Sept. 26	Camden, N. J.	*
Sept. 29	Akron, O.	Builders Exchange Bldg., N. Main St.

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*Concrete contractors planning to attend conferences in these cities are requested to get information about the meeting places from their local building material dealers.

A Concrete Contractor Who Believes in Merchandising

Charles F. Oetke of Lombard, Illinois, a concrete contractor, believes in the value of merchandising. He spends about $600 every year in advertising, carrying advertising in two newspapers and issuing a calendar which he sends to general contractors and builders.

Mr. Oetke's merchandising activity, however, does not stop with advertising. Leads that are developed through his advertising are followed up by a salesman, Mr. Winer, who makes it his business to keep in close contact with engineers, architects and building departments to find out what jobs are coming up.

Mr. Winer follows all contacts through in an effort to get the concrete work. For example, if the contract is let to a general contractor, Winer approaches him offering to sub-contract the concrete work.

Winer is constantly on the lookout for new business which he tries to develop himself as far as he is able. If he is unable to land a certain job, he sometimes calls on Mr. Oetke and the combined efforts of the two men generally are successful in landing it.

Building Soil-Saving Dams

The fact that rain water gullies develop into deep ditches—the marks of lost soil on the farm—means more business for alert concrete builders in rural sections. Small dams or bulkheads of concrete will allow surface water to flow off without cutting ditches and washing away the fertile soil from which the farmer derives his living.

Colored Sidewalk Tile in Artistic Patterns

Merchants Assert Colored Sidewalks Draw Customers — Designs Must Be Attractive — How Patterns Are Made — Working Agreement Between Contractor and Tile Manufacturer

By GEORGE RICE
Palo Alto, Calif.

Pink, green, tan, buff, gray and mixed colored sidewalks of concrete tile are not only making life brighter for pedestrians in many of the large cities, but they are publicity assets for the stores in front of which these attractive walks are laid. In most cases modernistic designs and colors are used, but in a subdued form as compared with the array of patterns and tints employed in other lines of decoration. The effectiveness of store sidewalks in color has its various phases, most of which are of a favorable nature.

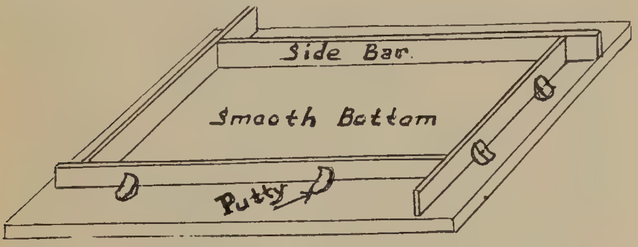


Figure 1. A plaster model of the contemplated sidewalk tile is cast in a form such as this

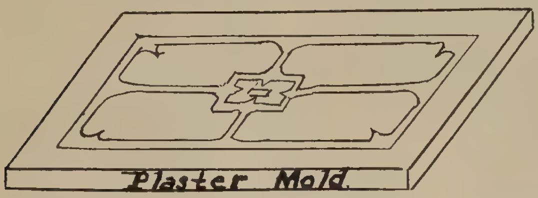


Figure 2. The plaster model is then incised with the proposed design

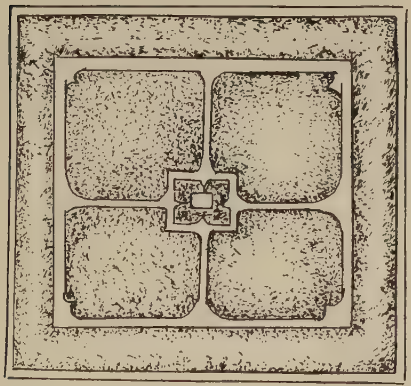


Figure 3. The required number of concrete tiles are then cast in a mold with the plaster tile as the model

"Flagging" Customers with Sidewalk Design

A number of merchants have come to my laboratory lately to inquire about colored concrete sidewalks for their store fronts, all of which indicates an interest in this class of handicraft.

Merchants assert that while the smooth, plain concrete sidewalks are easy to walk on, and easy to keep clean, they present nothing of a novel nature.

If, however, there is something in the layout of the sidewalk to attract the attention of the procession of people, a certain percentage of these people will lift their eyes from whatever has interested them there, to gaze into the show window. In the words of one proprietor of a store, "We can flag a lot of people with a sidewalk design."

Use Only Mineral Colors

Then again, we found that some walks were evidently colored with colors of organic nature, not capable of holding their brightness to the weather conditions of a sidewalk. Walks made up with colors of the mineral class which are made resistant with chemicals will not fade if the tile is properly constructed.

The successful use of color in concrete tile for sidewalks depends more upon the proportion of the color to the cement than is generally supposed. The manufacturers of cement colors are producing superior grades of colors, but our experience has been that some colored concrete sidewalk tile artisans proceed with their coloring operations without doing anything to nullify the disintegrating effect upon the color due to the lime in the cement.

Tiles for Sidewalks Must Be Hard

Concrete tiles intended to be walked upon must be hard, and ordinarily made under a considerable pressure. But tiles for use as patterns or as models can be made in a mold. If a good cement back is put on the tile and it is tamped in the mold, the model will stand fairly hard service as it is. A strong mixture of sand and cement should be used, according to the nature of the pattern tile to be made. A plaster model can be made on a smooth, flat surface by pouring the mixture into a mold set up with side or retaining bars similar to that shown in Figure 1. The plaster model is then incised with the proposed design as represented in Figure 2. This model is used for producing a concrete tile which may be all gray as shown in Figure 3, or a gravel and cement mixture may be used to produce a rough texture, or neat cement may be employed, introduced for the purpose of giving tone effects. The incised lines in the plaster model produce the pattern in relief in the tile, so that if desired, a design effect can be produced by pouring colored cement on the tile between these relief lines.

Or the first tile cast with plaster as the model can be used in turn for a second model which will produce the lines of the design in the tile cast from it in the original incised form, and these incised lines then can be filled with colored cement.

Co-operating with a Tile Manufacturer

It is not suggested that a contractor should undertake the actual manufacture of colored sidewalk tile. His opportunity lies in the direction of making a working agreement with a tile manufacturer through which the contractor uses the manufacturer's product, and together they can work out the patterns for individual locations. Through such an arrangement the contractor is assured of a reliable product that will stand service, and the manufacturer is assured of a market.

Using Earth Walls for Forms

In building monolithic concrete foundations for small buildings without basements the earth walls of the foundation trench may serve as forms if excavated carefully so that sides are even and vertical. Provide spread for the footing by cutting the trench a little wider at the bottom. Care should be taken, when depositing or spading the concrete, that earth is not pushed into the trench.

Large Volume of Concrete in Miniature Golf Courses

One Course May Require 100 to 300 Cu. Yd.—2,200 Courses Built and Under Construction in Los Angeles County—Concrete Work Includes Walks, Curbs, Bases for Tees, Fairways and Greens, Foot Bridges, Ponds and Fountains

MINIATURE golf is rapidly developing into a big business for concrete contractors and others. A surprising amount of concrete work is required in one of these little courses, while the number of courses being built is even more surprising.

In some cities hundreds of lots that were vacant a short time ago have been converted into profitable putting courses. Concrete, it has been found, is the material best adapted to building much of the courses, concrete bases for tees, fairways and greens and concrete walks being used regularly. A single 18-hole course of a character such as this article describes may require anywhere from 100 to 300 cu. yd. of concrete. With 2,200 courses built and under construction in Los Angeles County alone, the great volume of concrete work involved may be understood.

The most popular courses are those which have the neatest appearance coupled with permanent construction. Makeshift construction does not, as a rule, meet with public approval, and temporary courses soon lose their patronage to the permanent ones. This fact, along with the necessity for using a plastic material to attain certain shapes and forms for hazards, makes concrete necessary in miniature golf course construction. Therefore, the contractor who specializes in concrete work is offered an excellent market wherever miniature golf courses are being built.

Miniature golf courses usually are built on areas from 60 by 120 feet up to lots 300 by 300 feet in size. The more elaborate the course, the more area required. There is no set plan or arrangement to follow for laying out a course. The builder can use a great deal of originality in the layout and detail. Courses usually have 18 holes with the customary water hazards, bunkers, elevated tees and difficult passes. This makes concrete construction almost a necessity, as a plastic material is needed for building banked fairways and other special features.

Construction view showing concrete base for fairway and bunkers on miniature golf course. Material used for "grass" will be cemented to the concrete

Concrete Work Required

After the course has been laid out and all of the hazards located, the concrete bases for the tees, fairways and greens are placed. These slabs generally are 3 inches thick. Where frost conditions and drainage are items to consider, a fill of tamped cinders or gravel and drain tile may be used to form a sub-base for the concrete, and a heavier slab sometimes is laid.

Attractive concrete walks add to the appearance of the putting course

A 3-inch curb and an 18-inch or 24-inch concrete walk usually are built around each unit composed of tee, fairway and green. The curb permits banking shots much as in billiards. The 18-inch walk provides standing space for partners out of play, and carries the traffic from tee to green, thus saving the surface of the fairway from the excessive wear it would otherwise have to stand.

Concrete sidewalks 3 feet wide connect each green and succeeding tee. This carries the heavy traffic between holes and saves the lawns from the wear and tear they would otherwise receive.

Fairways are often made to follow banked curves, sharp turns and angles, as well as up hills, over bridges and through tunnels. The fairways vary in length from 15 to 50 feet and sometimes are even longer, depending on the size of the course itself and the amount of detail in the entire layout.

The appearance of the course depends to a large extent on the landscape treatment. A rustic effect is often made by embedding various colored stones in the concrete work. Colored concrete likewise tends to add cheerfulness and life to the layout. Concrete fountains, pools, lily ponds and rustic concrete, including bridges, are also used.

The use of stucco on the cashier's office or other service buildings often helps to increase the attractiveness of the court. Concrete seats and attractive tables shaded by colored beach umbrellas add a restful note of comfort to the miniature course.

Cementing "Grass" to the Concrete Slab

Various materials have been used to cover the concrete bases for tees, fairways and greens. Various types of green felt, dyed cotton seed hulls, thin layers of sand and dyed jute pads are being used. The hair felt pad or synthetic grass, as it is called, is cemented to the concrete slab with refined asphalt or similar waterproof cement in much the same manner as linoleum is cemented to a concrete floor.

A bird's-eye view of a course employing a tremendous amount of concrete

The cost of building a course depends on its size, the amount of detail in landscaping, the cost of the land lease, the type of construction, concessions included in the arrangement and the royalties paid patent holders where surfacing materials used involve patent rights.

5,000 Courses in Southern California

The astounding growth of the game has come as a result of real public demand. Nothing in the amusement field since the advent of the movies has commanded general public interest as rapidly as have these small golf courses. A woman in Chattanooga, Tenn., is said to have started the craze. She built a course in her back yard for her own use, and from this southern city the game has spread to almost all sections of the country. Florida probably was first to take up miniature golf and give it a feverish start. From Florida the fascination of miniature golf moved to Los Angeles, where interest in the game has reached its greatest momentum. In the city of Los Angeles alone there are now 600 courses doing an unusually profitable business. In Los Angeles County, including the city, 1,600 additional courses are being built. In fact, present indications are that by the end of 1930 there will be 5,000 or more miniature golf courses scattered over southern California.

Northern Cities Adopt Game

Northern sections of the country are no less affected, for a recent estimate by a real estate writer places the number of courses in Chicago and vicinity at 600, with 2,400 employees. In the smaller northern cities the story is the same. A typical case is reported from Muskegon, Mich., where ten courses are in operation and another, much larger than previous ones, is under construction.

Employment for Many

Construction work on the 1,600 courses in Los Angeles County gives employment to 8,500 men, and it takes 2,000 more to operate the 600 courses now in business. A further measure of the interest Californians have in the game can be obtained from the fact that the 600 courses operating in Los Angeles do an average daily business of $50,000. It is said that from 150 to 650 people drive from the first tee on every course daily. From 25 to 35 cents is charged for playing an 18-hole course, with a slightly reduced fee for the second 18 holes of a 36-hole game.

While this business has not had the same frenzied growth in other sections of the country as in California and Florida, most large cities are taking it up, and the smaller towns are adding their share to the spread of the game. The future of the miniature golf business can best be gauged by the fact that on the west coast the large theatre syndicates are buying up these small courses by the hundreds, improving them and promoting the game. And they are building new ones where the territory warrants it.

Enterprising owners of these miniature courses have adopted various schemes to attract the public. Prizes are offered for low individual or team scores. Gold watches, diamond rings, and sometimes automobiles are offered to stimulate interest. In some places championship tournaments become the vogue and playing is carried over 24 hours of the day to accommodate all the entrants.

Proper lighting is a feature which also attracts patronage, for night playing has proved as popular as the game played in the daytime. In fact, the night players on many courses outnumber those who play during the day.

Popularity Assured

That the game is extremely popular needs no proof. Its future seems assured. In fact, the game has risen to such heights that already the dweller in the large city may turn to the roof tops of skyscrapers for his daily round of golf. Bearing in mind the unusual popularity of the game, its phenomenal growth in certain sections of the country, the adaptability of concrete to construction of the course, and the almost unlimited field for promoting more courses, the possibilities for business for concrete contractors from this source seems assured.

Portland Cement Mortar

For laying concrete block and building tile a mortar composed of one part portland cement, one part lime and not more than six parts sand, all measured by volume, is considered satisfactory for ordinary work. Where extra strength and density are desired a mortar consisting of one sack portland cement to three cubic feet of sand and ten pounds of lime is recommended.

Watertight Concrete

Moisture is necessary for dense, watertight concrete. If this fact is kept in mind no difficulties will be encountered in the curing of concrete. Floors and walks are commonly given a covering of two or three inches of earth, straw or sand, which is kept moist by sprinkling for ten days. Wall sections are best protected with moist canvas or burlap.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Assistant General Manager, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wisconsin.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago. Semi-annual meeting, October 20th to 22nd, at Briarcliff Lodge, Westchester County, New York.

Haydite Manufacturers' Association; Dan F. Servey, Secretary-Treasurer, 203 Mutual Building, Kansas City, Mo.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 W. Grand Ave., Chicago.

National Association of Paris Transit Mixed Concrete Manufacturers; Chas. P. Maloney, Secretary, E. Water and E. Salmon Streets, Portland, Oregon.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; Headquarters, 27 Barbeau Street, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wisconsin.

The Concrete Industry
—25 YEARS AGO

A HOLLOW concrete block chimney constructed in 1903 at the plant of the Peerless Portland Cement Company, Union City, Michigan, is described and illustrated in a brief article in the September, 1905, issue of CONCRETE.

"The internal diameter," it is stated, "is uniform, being three feet at all points. The width of the blocks varies from 20 inches at the bottom to 8 inches at the top. The molds were adjustable so that there is a uniform slope on the outside of the chimney."

* * *

CONSUMPTION of cement in the United States, according to a tabulation, in 1900, was 8,482,020 barrels, and in 1904 had jumped to 26,505,881.

Present-day production is about 171,000,000 barrels annually.

* * *

RECOGNITION of the importance of waterproofing was made in the September, 1905, issue of *Cement Age* in the inauguration of a department for the discussion of all phases of the subject as related to engineering and architectural work.

* * *

S. B. NEWBERRY, in a paper entitled, "Hollow Concrete Block Building Construction," reprinted after presentation before the Association of American Portland Cement Manufacturers' meeting, makes recommendations concerning proportions, manufacture, color and cost and selling price.

* * *

"TWO interesting features at the Louisiana Purchase Exposition," states an article, "were the United States Fuel Testing Plant under the direction of the United States Geological Survey, and the collective Portland Cement Exhibit and Model Testing Laboratory of the Association of American Portland Cement Manufacturers."

* * *

"THE Philadelphia Specifications for Concrete Building Blocks" covers in detail the modified law in that city regarding the manufacture and use of the masonry units.

Some of the provisions are as follows:

"The material must be subjected to the following tests: Transverse, compression, absorption, freezing and fire. Additional tests may be called for when, in the judgment of the superintendent, the same may be necessary.

"Tests shall be made in series of at least five, except that in the fire tests a series of two (four samples) is sufficient. The transverse tests shall be made first on full-size samples (8 by 4 by 2). The resulting half samples are then used for the compression and absorption tests, but in no case must both halves of the same piece be used in either series."

Detailed directions for making all tests follow.

Two of the conditions upon which approval depend are as follows:

"(a) A brand mark for identification must be impressed on or otherwise attached to the material.

"(b) A plant for the production of the material must be in full operation when the official tests are made."

New Equipment and Materials

Aluminum Letters and Figures for Marking of Concrete

H. W. Knight and Son, Seneca Falls, N. Y., have now made available aluminum letters and figures for imprinting grave markers, monuments and other concrete products.

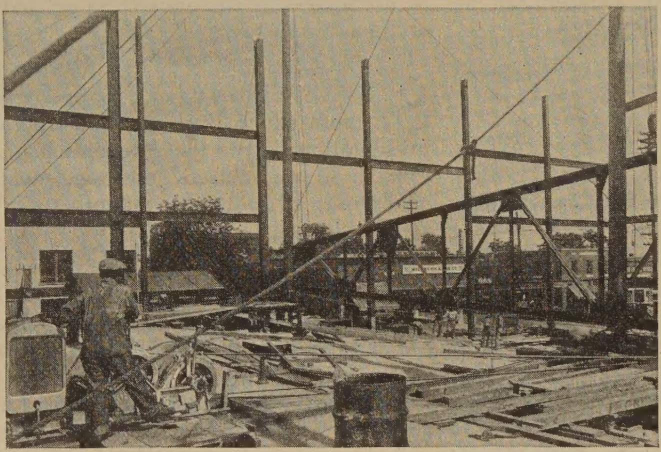
They are used one at a time, with a straight edge, and have finger holds cast on the backs. They are manufactured in four sizes, from 1 in. to 2 in.

Other devices produced by the firm are name stamps, hollow dies for producing raised letters and figures, and brass letters and figures in a variety of sizes for permanently embedding in concrete work.

Jaeger Hoist on Job

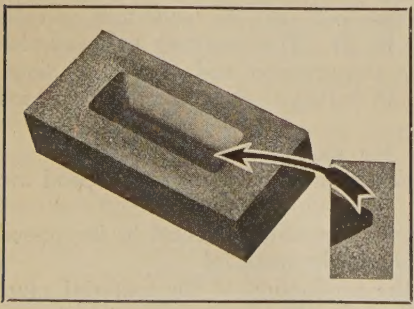
The accompanying illustration shows a 32 h.p. Jaeger Timken thrust hoist being used on a job by M. E. Gillioz, Monett, Mo. In this instance, it is being used to erect steel trusses in connection with two gin poles, one drum line leading to each pole. Featherweight controls and positive brakes enable the operator to set the truss in exact position, the manufacturer states.

These outfits are also being used for pile driving, for dragline hauls, for material hoisting and in connection with Lakewood or other mast plants or towers.



"Frog" Is Feature of New Dunbrik

Illustrated below is the unit produced on the new Dunbrik machine, for which the manufacturers claim a capacity of about 24,000 standard size brick a day. The unit is said to be 20 per cent lighter in weight than ordinary brick.



The elimination of porosity of the faces of the unit is accomplished in the production travel, by smooth steel plates which form part of the machine and act as a trowel, giving both faces of each brick a water-repellent surface, the W. E. Dunn Manufacturing Co., Holland, Michigan, states.

A brief description of the machine appeared on this page in the June issue of CONCRETE.

Complete Storage and Batching Equipment Now Furnished by Heltzel

Complete equipment for the storing and batching of bulk cement is now furnished by the Heltzel Steel Form and Iron Company, Warren, Ohio.

The basic bin of the Heltzel plant is a portable all-riveted bin having a capacity of 125 bbls. of cement. By adding an inexpensive extension, capacity can be increased to 320 bbls., it is stated.

The bin is loaded by a vertical elevator and when desired a power shovel for unloading the bulk cement from box cars can also be furnished. The flow of cement from the bin to the batcher is controlled by a rotary valve arrangement.

The cement batcher is dustproof, making the use of a dust jacket unnecessary, and eliminating all cement waste, it is claimed. Weighing is done with an automatic springless dial type of scale, which allows the operator to back-check every batch without moving any counterpoises, according to the manufacturer.

Industrial Literature

Gray Portland Cement—Waterproofed

"How to Make Good Waterproofed Concrete" is the title of a 28-page book just issued by the *Medusa Portland Cement Company,* Cleveland, Ohio, and featuring the use of Medusa gray portland cement—waterproofed.

Among the interesting features brought out in this book is a graphic test showing the advantages of the use of waterproofed cement. The subject of why concrete should be waterproofed is dealt with, as is also the advantage of mill-mixed waterproofed cement. Complete specifications and details for the making of a permanent, waterproofed concrete are given. The publication tells also how to waterproof concrete and masonry both above and below grade and gives the specifications and use for waterproofed mortars. Specifications for waterproofed concrete blocks, for waterproofing existing work, waterproofing in home construction, mercantile buildings, factories, swimming pools, etc., are also given. The book itself is profusely illustrated.

Complete Pipe Data

Information on concrete pipe, reinforced and unreinforced, with charts of tests to show the strength of concrete pipe of thin dimensions, the wall thicknesses, specifications for bell end, reinforcement specifications and the cost of producing pipe are some of the data that add to the value of the *Quinn Concrete Pipe* loose-leaf catalog, published recently by the *Quinn Wire and Iron Works,* Boone, Iowa.

Its 40 pages contain in addition full information regarding the various types and models of Quinn heavy duty machines, operating instructions, specifications, and so forth, as well as photographs, letters and other information from present large pipe manufacturers.

Fisher Laboratory Apparatus

Compression testing machine, cement molds, sieves, riffle, and a tester are some of the apparatus and accessories cataloged in a new 16-page booklet just published by the *Fisher Scientific Company,* Pittsburgh, Pa.

Another piece of literature describes and illustrates the operation of Slide-Lock molds for concrete testing.

MARKED
AND CERTIFIED

The Standard Association Symbol ● rolled on rail steel reinforcing bars produced by the member mills listed below, positively identifies material meeting quality requirements of specification A16-14 of the American Society for Testing Materials—a standard grade reinforcement universally recognized and having a background of twenty years successful use in the world's finest concrete structures. Architects and engineers can specify this mark as an assurance of standard certified quality.

Buffalo Steel Company	Tonawanda, N. Y.
Calumet Steel Company	Chicago, Ill.
Connors Steel Company	Birmingham, Ala.
Franklin Steel Works	Franklin, Pa.
Laclede Steel Company	St. Louis, Mo.
Missouri Rolling Mill Corporation	St. Louis, Mo.
Pollak Steel Company	Cincinnati, Ohio
West Virginia Rail Company	Huntington, W. Va.

Mills in Canada:

Burlington Steel Company Limited	Hamilton
Canadian Tube and Steel Products Ltd.	Montreal

● *For further information write*

Rail Steel Bar Association, Builders Bldg., Chicago

RAIL STEEL
for concrete reinforcing

About Makers of Equipment and Materials

Industrial Literature

Grid Flat Slab Floor Construction

The Grid Flat Slab Corporation, 761 Dudley Street, Boston, Mass., has issued a 4-page printed folder showing the method of centering for the *Grid system* of reinforced concrete construction, and another leaflet describing other features of the system.

The Grid system is essentially a 2-way flat slab type of floor and column construction, the system having column heads and drop panels as in ordinary flat slab designs. However, the dead weight of the floor is reduced by means of square steel domes placed over the entire floor area outside the drop panel. The domes are removable, and each dome replaces about 1½ cu. ft. of concrete. They are made of No. 16 gauge metal, are 19 in. square at the upper surface, as placed, and 24 in. square at the bottom, the bottom flaring out to a 2½-in. flange to form the joists. This makes the joists 5 in. wide at the bottom and places them 29 in. center to center in each direction.

In most designs, it is said, the bottom of the joists can be made flush with the bottom of the drop panel, thereby avoiding the vertical offset ordinarily occurring at the edges of the drop panel.

Small Job Equipment

"Bigger Dollars from the Small Job" is the title of a new broadside issued by the *National Equipment Corporation,* Milwaukee, Wis., in the interest of *Smith, C. H. & E.* and *Kwik-Mix* products.

Ten units of various kinds are pictured, each accompanied by a brief description and a reference to the catalog containing detailed information.

Haydite Floor Tile

A brief description and two illustrations of Haydite floor tile for beam construction are contained in the 12-page booklet, *"Concrete Masonry—Haydite Building Units,"* published by the Portland Cement Association in behalf of the *Haydite Company,* Kansas City, Mo.

It is pointed out that these tile are true as to size and make a perfect plaster base.

Complete B-G Line

For the first time the entire line of material handling machinery produced by the *Barber-Greene Company,* Aurora, Ill., has been compiled into a single book, named *"The Barber-Greene Line."* This is a 32-page catalog issued as a general review of all the various machines.

A page is devoted to each machine and contains a large posed photograph, a brief description, and general specifications and features.

Cement Color Leaflet

Description of Anchor brand cement colors is comprised in the 16-page leaflet just issued by *C. K. Williams & Co.,* Easton, Pa.

A color card on one page bears eight shades and directions for using this brand of cement colors follow. Amount to use, test panels, mixing operation, application and securing of tile effect are told about.

Butler Central Mixing Plants

A 16-page booklet, *No.* 190, just published by the *Butler Bin Company,* Waukesha, Wis., deals with Butler commercial concrete plants for the wet batch method.

Installations of different sizes are illustrated, and three full-page layouts are shown.

Compressor Catalog

"Labor Saving Pneumatic Equipment" is a new 12-page booklet telling in detail about 13 various compressor units. Outfits for spraying, bush hammering, and similar work are described and illustrated; specifications are given. This is one of the recent publications of *P. K. Lindsay & Co.,* Boston, Mass.

Lift Truck Features

Catalog No. 123, issued recently by the *Barrett-Cravens Company,* Chicago, announces a new multiple lift truck having several noteworthy features. Among them are the spring handle holdup, the automatic releasing latch to prevent the handle from flying up, and special long leverage lifting mechanism to insure easier lift.

Notes From the Field

Rex Representatives

The Equipment Corporation of Arizona at Phoenix, *F. C. Crane Company* of Dallas, Texas; *Joe C. Tucker* of Morganfield, Ky.; *Track-Type Tractor and Equipment Company* of Amarillo, Texas, and *Concrete Products Company* of Oakland, Calif., will handle the complete line of Rex construction equipment, manufactured by the *Chain Belt Co.,* Milwaukee, Wis.

Carborundum Purchases Glue Firm

Announcement has been made by the *Carborundum Company* of the purchase of the abrasive division of the *American Glue Company.* The purchase was effective as of August 8th and the new organization will be known as the *Union Sand Paper Division* of the *Carborundum Company.*

Manufacturing operations will be continued at the Union plant at East Walpole, Mass., and at Brantford, Ontario, where all of the established brands of coated abrasive products under the titles of Union brand, Alumite brand and various other established trade names will be produced.

Masonite Buys Dowd Form System

The Masonite Corporation has bought outright the *Dowd Concrete Form System, Inc.,* it was announced recently by *Brown Katzenbach,* vice president.

The Dowd System rented concrete forms made of presdwood on a royalty basis, and the Masonite Corporation will now make the Dowd concrete form system available to all contractors without charge, the announcement states.

This service will be under the management of E. B. Bushnell, head of the concrete form department.

Dump Body Trucks Added to Ford Line

Addition of five dump body trucks to the line of standard Model AA 1½-ton trucks has been announced by the *Ford Motor Company.* They offer a wide range as to price, hoisting method and capacity.

The Ford dump trucks include an hydraulic dump body with hoist of one and one-half tons normal operating capacity; a heavy duty hydraulic dump body; a mechanical dump body; gravity dump body; and hand dump body.

Industrial Movie Talks About Wire Rope

A "talkie" industrial motion picture has been produced by the *American Steel & Wire Company* featuring a trip through the mills in which wire rope is made.

As each stage of manufacture is viewed it is orally explained in a detailed manner.

Clark Is Genfire Manager

Paul R. Clark, formerly president of the Fireproof Products Company, has been appointed New York district manager of the *Genfire Steel Company,* with offices at 31 Union Square, New York City, and 605 Broad Street, Newark, N. J.